ETRI 한국전자통신연구원
Electronics and Telecommunications
Research Institute

Way Maker, ETRI

2024 ETRI
Technology Report
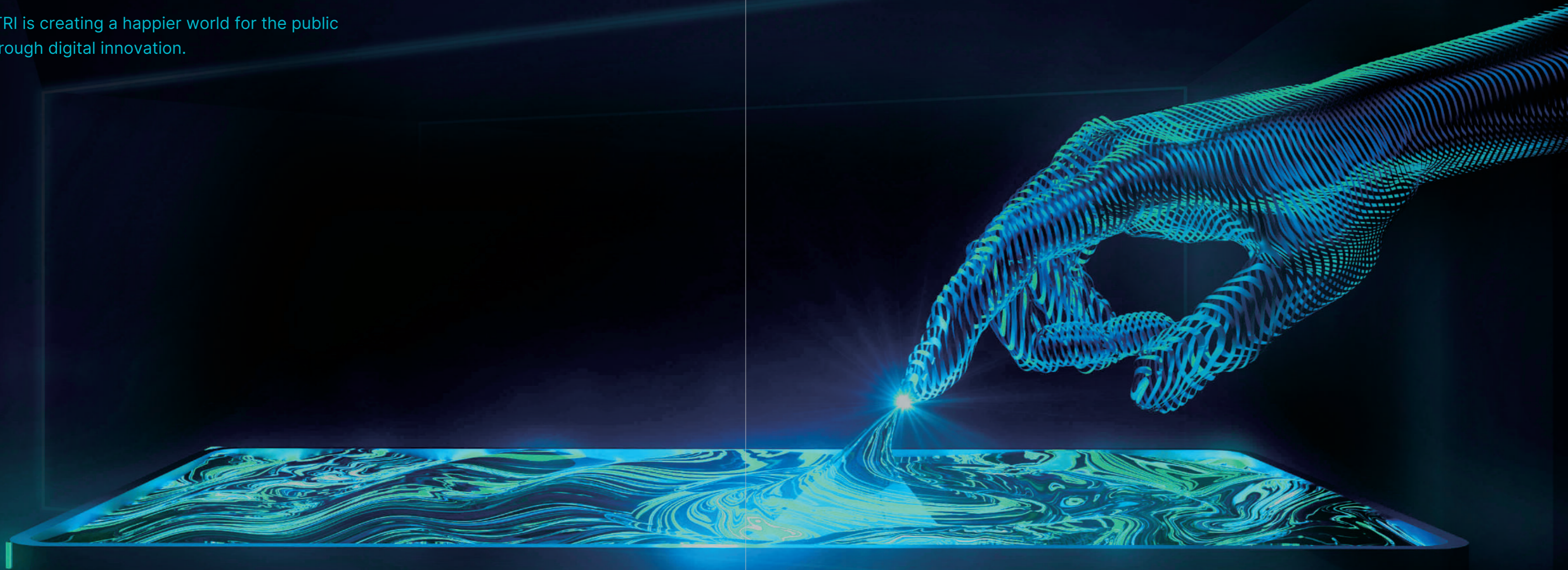
ETRI

2024 ETRI
Technology Report

WAY MAKER,
ETRI

ETRI is creating a happier world for the public
through digital innovation.

INNOVATIVE PIONEER, ETRI

ETRI is pioneering a new future
with an unrelenting spirit of challenge.

President Greeting

We now face a global era that changes every minute.

I believe the most important thing in such an era is to develop the ability to quickly
comprehend the international situation and respond to the changes.

Last year, the government designated 12 national strategic technologies.
Most of these, such as semiconductors, displays, secondary batteries, advanced mobility,
cyber-security, artificial intelligence, next-generation communication, advanced robots and
manufacturing and quantum technologies, are based on information and communication technology.
Therefore, ETRI bears a heavy burden, indeed.

ETRI, as the largest government-funded ICT research institute in Korea, also has the responsibility of leading the
development of the ICT industry and contributing to the nation's innovation and growth
by developing intelligence information technology for the future.

In addition, along with the missions of R&D, corporate support and service,
we must fulfill our roles in providing the infrastructure for super-intelligent information society,
realizing super-performance computing, achieving hyper-connected infrastructure,
realizing ultra-realistic services and developing converged national intellectualization technology.

Accordingly, ETRI designated 6 core strategic technologies and is fully promoting the mission-centric R&D.
These include artificial intelligence semiconductor and computing, security technology, AI and software,
6G communication, metaverse and digital convergence technology.
ETRI will strive to innovate the nation and society digitally by achieving these 6 core strategic
technologies within the given period.

I intend to lead the innovation by continuously researching and developing the technologies
with the help of the newly created research organization.

All employees of ETRI will work together and give their best efforts to research and development,
so that the people can enjoy more comfortable, safer and happier world.

I would appreciate your heartfelt support and encouragement for ETRI,
so that it will be loved and recognized by the people and become the best research institute in Korea.

ETRI will play its role as the technology pioneer that creates happier future through digital innovation.

Thank you.

President,
Electronics and
Telecommunications Research Institute

GENERAL STATUS

Personnel

(As of Apr. 30. 2024)

Total No. of Employees
2,274

Type of Work

Board Member/Administrative Staff 7.48%	Research/Technical Staff 87.25%	Assistant Staff 5.28%
170	1,984	120

Status of Degree Holding

Doctoral 51.80%	Master 36.76%	Bachelor 11.43%
1,178	836	260

Project Status

(As of Dec. 31. 2023)

No. of Projects (Cases / Total of Past 5yrs)
3,207

No.of Projects (unit: Cases)

2019	2020	2021	2022	2023
599	650	637	658	663

Budgets (100 Million KRW / Avg. of Past 5yrs)
5,758

Budget (unit: 100 Million KRW)

2019	2020	2021	2022	2023
4,925	5,189	5,827	6,260	6,590
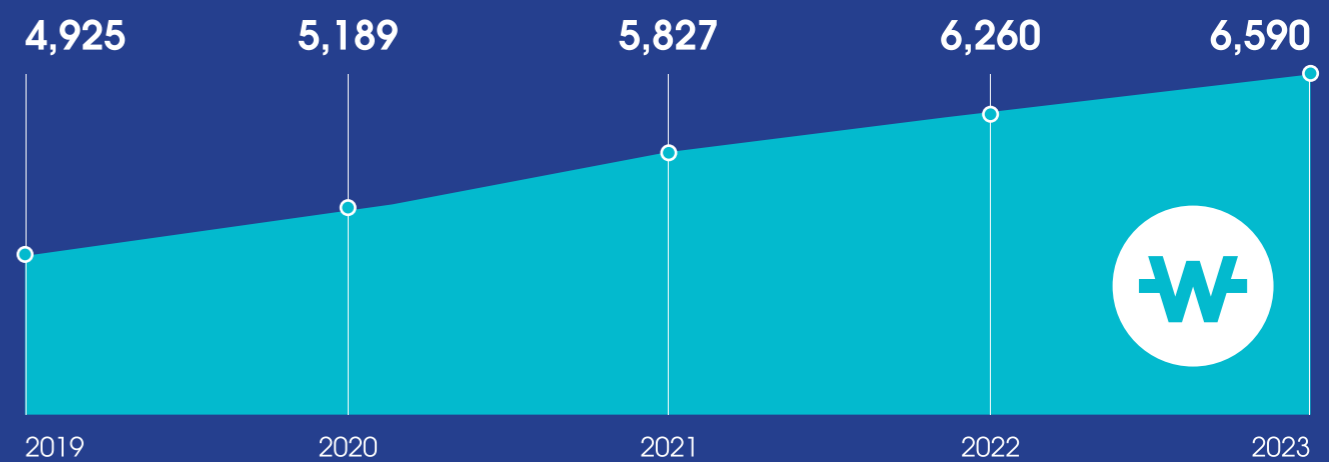
Patent Application

(As of Dec. 31. 2023)

No. of Patent Applications in 2023 (Cases)
2,984

Domestic	International
2,029	**955**
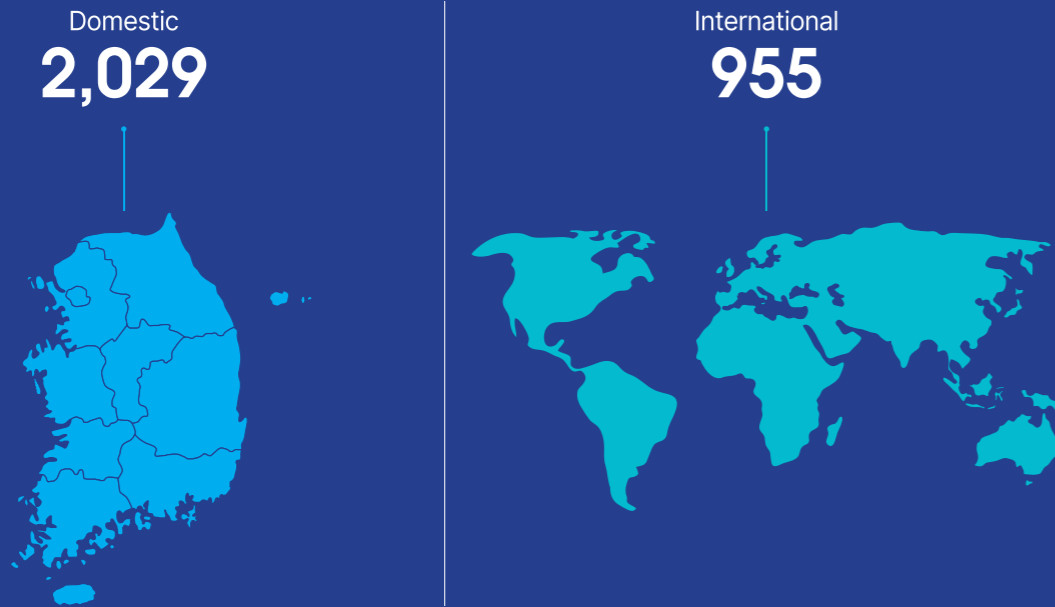
(2019 to 2023)

No. of Patent Applications (Cases / Total of Past 5yrs)
13,946

2019yrs → **2023**yrs

Technology Transfer

(As of Dec. 31. 2023)

No. of Technology
(Cases / Total of Past 5yrs)

1,555

2019	2020	2021	2022	2023
257	304	370	320	304
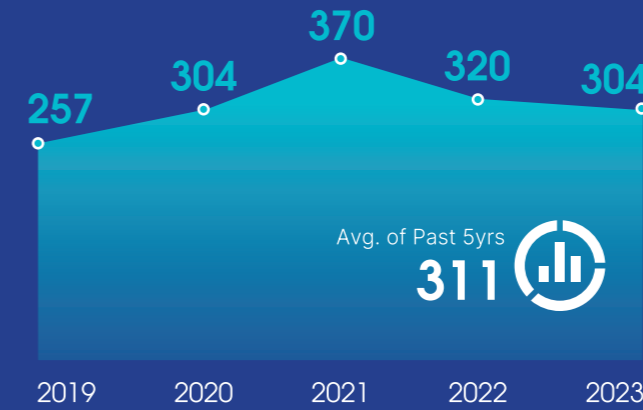
Avg. of Past 5yrs
311

Royalty Income
(100 Million KRW / Total of Past 5yrs)

2,718

2019	2020	2021	2022	2023
501	639	531	502	545
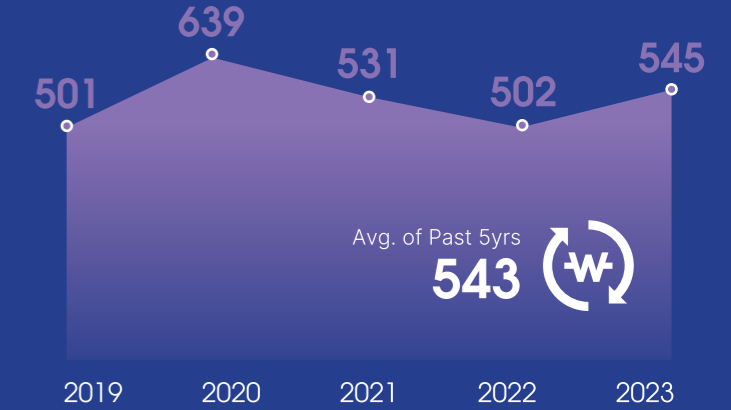
Avg. of Past 5yrs
543

No. of Technology Transfer Companies
(Cases / Total of Past 5yrs)

- ● SME
- ● Others

1,488

Avg. of Past 5yrs
297.6

	2019	2020	2021	2022	2023
Total	248	287	357	307	289
SME	241	284	349	297	286
Others	7	3	8	10	3
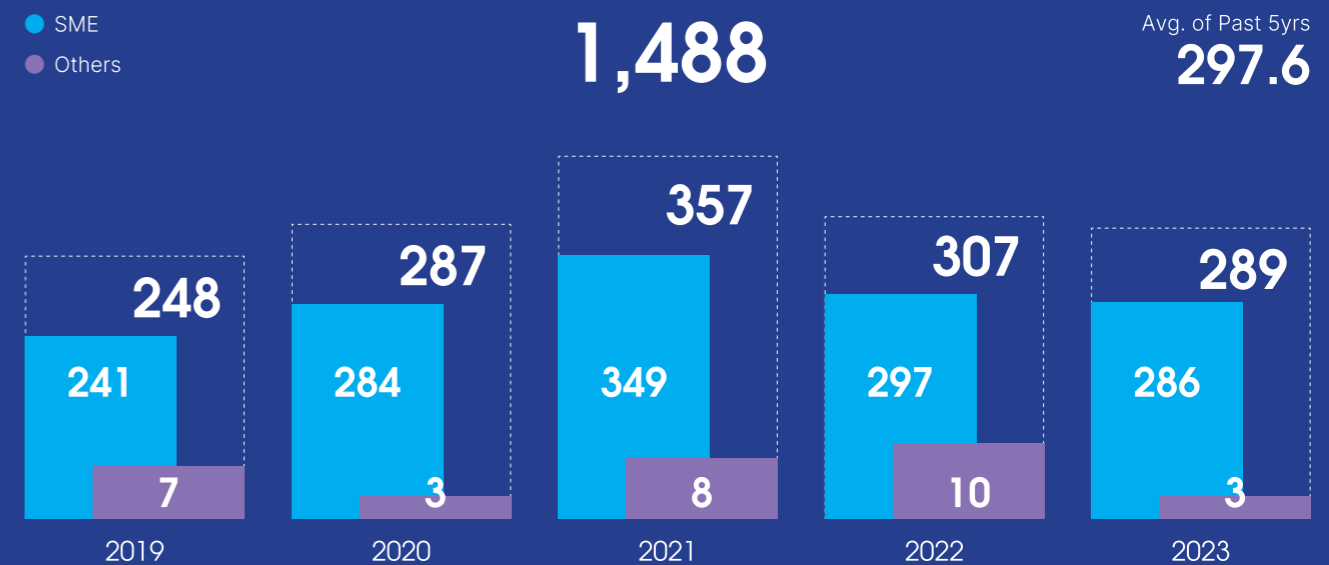
Standardization

(As of Dec. 31. 2023)

No. of Standards Contribution Adopted
(Cases / Total of Past 5yrs)

- ● Domestic
- ● International

3,008

	2019	2020	2021	2022	2023
Total	683	552	510	576	687
Domestic	583	437	414	490	600
International	100	115	96	86	87
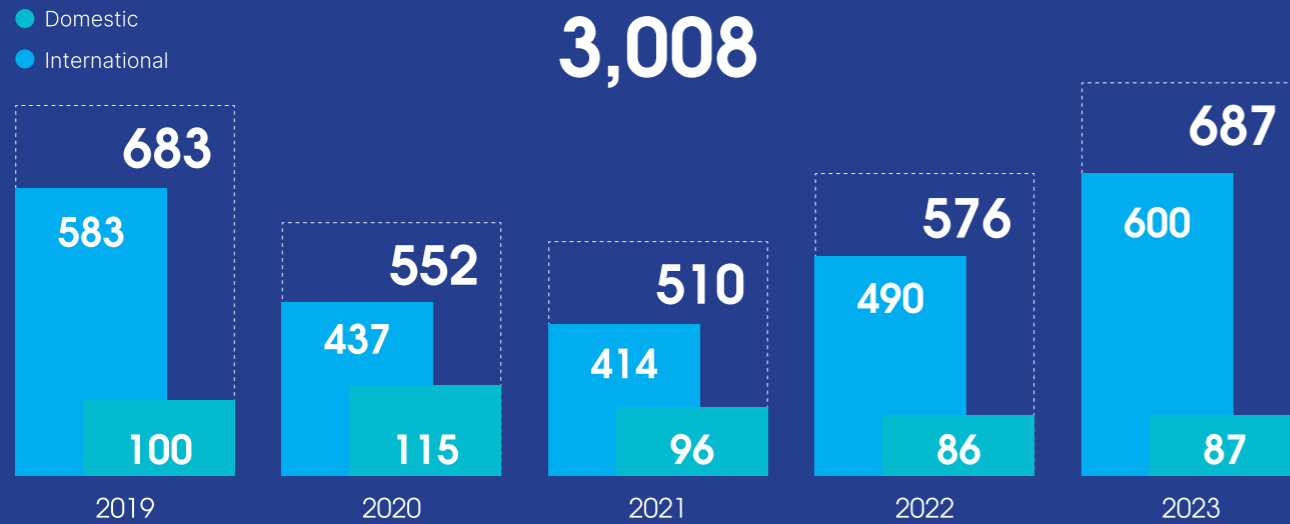
No. of Standard Leaders
(Avg. of Past 5yrs)

67.6

2019	2020	2021	2022	2023
62	65	67	68	76
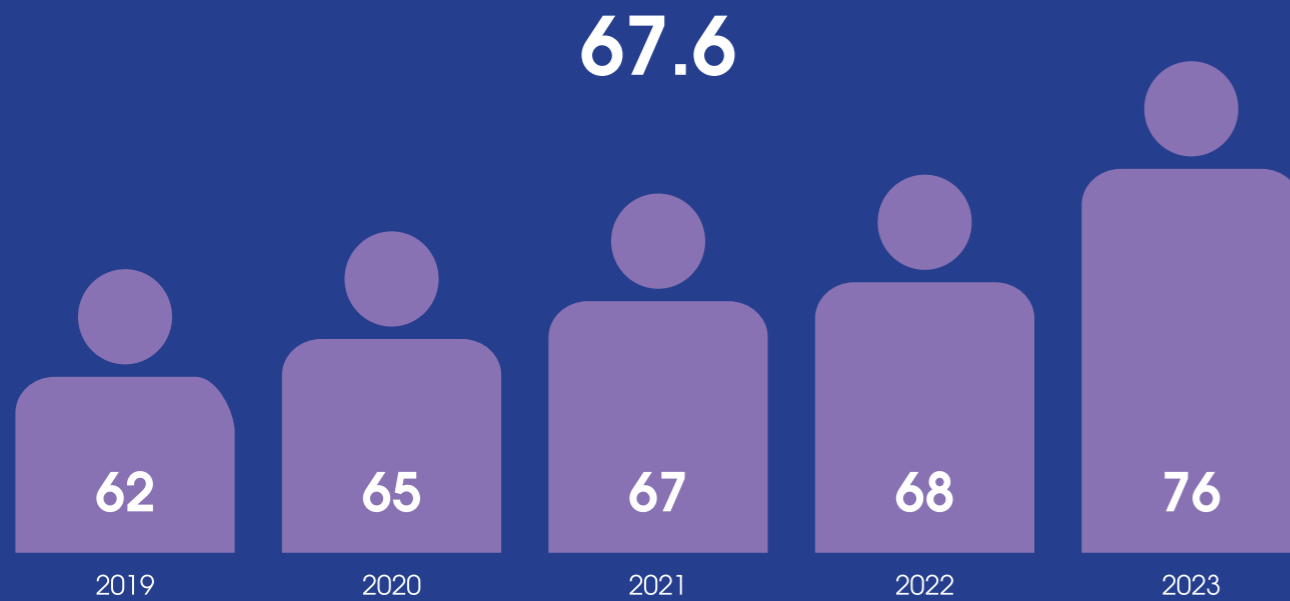
Papers

(As of Dec. 31. 2023)

No. of Papers
(Cases / Total of Past 5yrs)

- ● Domestic
- ● International

7,725

	2019	2020	2021	2022	2023
Total	1,374	1,447	1,517	1,682	1,705
Domestic	948	1,051	1,139	1,288	1,200
International	426	396	378	394	505
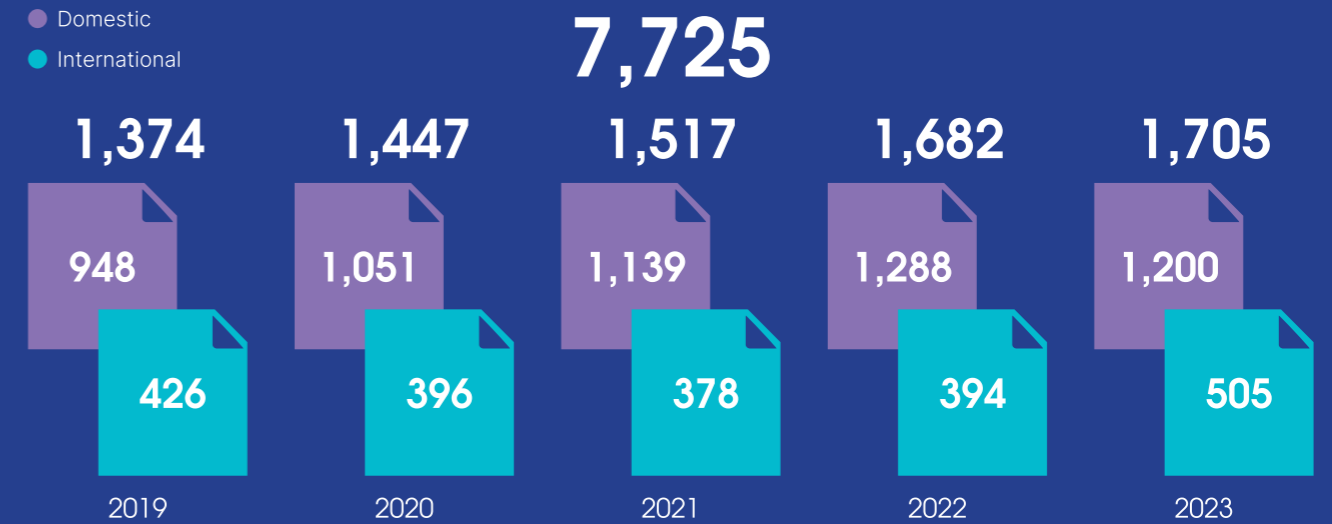
No. of SCI Papers
(Cases / Total of Past 5yrs)

- ● Average IF
- ● SCI Papers

1,374

Average IF: 3.94

	2019	2020	2021	2022	2023
Average IF	2.82	3.67	3.89	4.36	4.97
SCI Papers	223	288	289	291	283
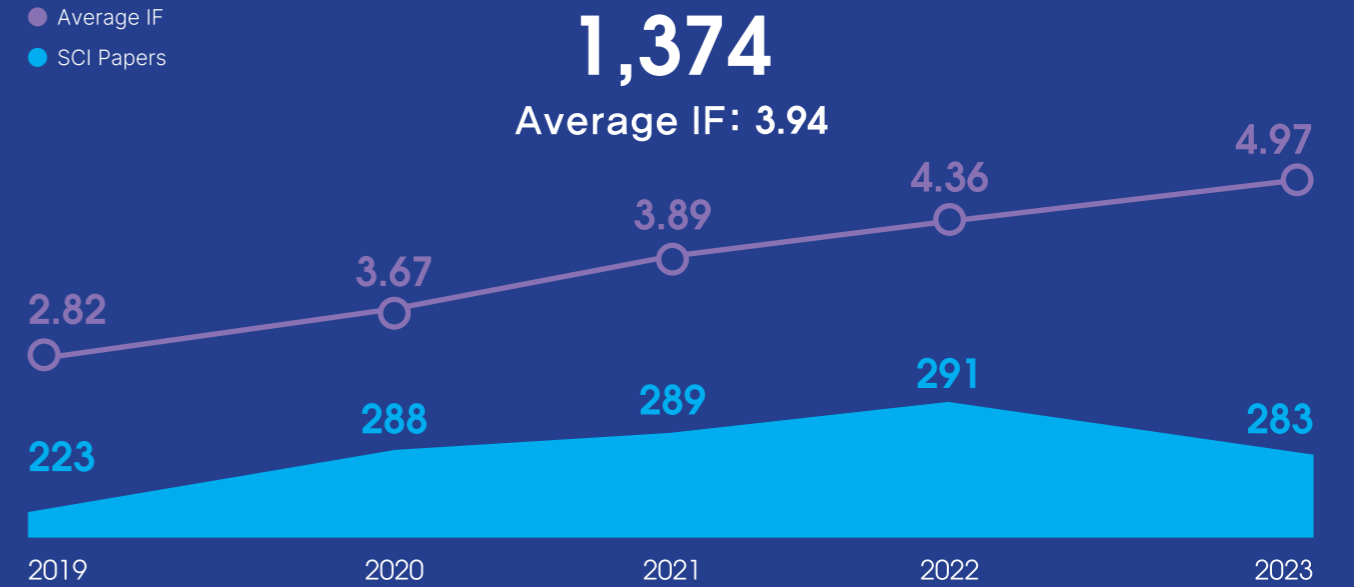
Status and Progress of ETRI Start-up

(As of Dec. 31. 2023)

857
No. of Companies
After the establishment of Sambo (Trigem) Computer in 1980, approx. 857 companies have been established

27
Initial Public Offering
27 of ETRI Alumni Companies are listed on the KOSPI [2], KOSDAQ [22], KONEX [3]

31.2 Billion KRW
Sales
As of end of 2023 Among 36 Companies Approx. 31.2 Billion KRW

Gachisoft(Co.)	BLUETILELAB(Co.)	Ymatics(Co.)
GonggamSensor(Co.)	BIBIM PLANETICo.)	INOPTIX(Co.)
GuberNet(Co.)	BnTSoft(Co.)	GeoAI(Co.)
NEWRATEK(Co.)	SOUNDUSTRY(Co.)	Coxlab(Co.)
Dr.i&B(Co.)	Solarinno(Co.)	Quantum AI(Co.)
THEPEACH(CO.)	SOLWITH(Co.)	CREADE(Co.)
Developtainment(Co.)	SMATCH(Co.)	ToBS communication(Co.)
DIGITALSENT(Co.)	SPACEFLIT(Co.)	Tutorus(Co.)
Dicto(Co.)	SPOTTER(Co.)	TEAM3F(Co.)
DeepLogicChain Inc.	Speech Laps(Co.)	Farm-In(Co.)
deep modal(Co.)	PINES&S(Co.)	pebblous(Co.)
DeepON(Co.)	ARKLINK(Co.)	Forsedu(Co.)
Lighting Labs Inc.	RCN(Co.)	Protos(Co.)
Radar&Space(Co.)	RTst(Co.)	FromBit(Co.)
Locaila(Co.)	ACROSSPACE(Co.)	play46(Co.)
LUCENTBLOCK(Co.)	EXOSYSTEMS(Co.)	HAJIYO(Co.)
Looko(Co.)	nspectra(Co.)	KSTT(Co.)
Magenta robotics(Co.)	elssen(Co.)	한국청정발전기술㈜
MetaRPAS(Co.)	mforus(Co.)	AID Korea(Co.)
(Co.)VITEALTH	oprocessor(Co.)	HANCOM AT(Co.)
Batoners(Co.)	AllNewSystems(Co.)	Hojeonable(Co.)
BWsystem(Co.)	Optella(Co.)	Holistic Manifold(Co.)
		HURA(Co.)

ETRI Laboratory Enterprise Status

(As of Dec. 31. 2023)

96
Registered Companies
ETRI has set up 96 ETRI Laboratoy Enterprises through successful commercialization of research outcomes since 2007.

64
Companies in Operation
64 ETRI laboratory Enterprises in Operation

kokonut(Co.)	Secuworks(Co.)	IN2WISE(Co.)
GAION(Co.)	icerti(Co.)	INTU Works(Co.)
Gamma Spectra(Co.)	EYEQ Lab Inc.	JUNGSANGLIDAR(Co.)
Gridaenergy(Co.)	RNSlab(Co.)	JNE WORKS(Co.)
GIRJAESOFT(Co.)	Antrorse(Co.)	Gene System(Co.)
NEOSTACK(Co.)	URBAN DATA LAB(Co.)	Connect Brick(Co.)
Devstack Inc.	EDINT	CORE MOVEMENT(Co.)
DEEP INSPECTION(Co.)	AI Systems(Co.)	curaum(Co.)
Leadpointsystem Inc.	Altech(Co.)	Cruxell(Co.)
Market Of Material(Co.)	NDOS(Co.)	TEXTORY(Co.)
MOLPAX BIO(Co.)	MDHI(Co.)	To be smart(Co)
Movto	Optella(Co.)	TIIMBIO(Co.)
MINTROBO(Co.)	Optiple(Co.)	Fionsystems(Co.)
Biosenstech(Co.)	Y-tech(Co.)	ParkingGo(Co.)
VODABI(Co.)	Wooksung Media(Co.)	FARMCONNECT(Co.)
BEAUnex(Co.)	Withmind(Co.)	4ind(Co.)
Blue Tile Lab(Co.)	UNIAI(Corp.)	PDXen(Co.)
BTWorks(Co.)	UGS(Co.)	HarborMAX(Co.)
SALUS MS(Co.)	(Co.)InnoRay	HANCOMINTERFREE(Co.)
SHAREBOX(Co.)	E&D(Co.)	Hojeonable(Co.)
SHARECHEM(Co.)	Eintelligence(Co.)	
StandingTALL(Co.)	EPhotonics(Co.)	

Nationwide Regional Research Center
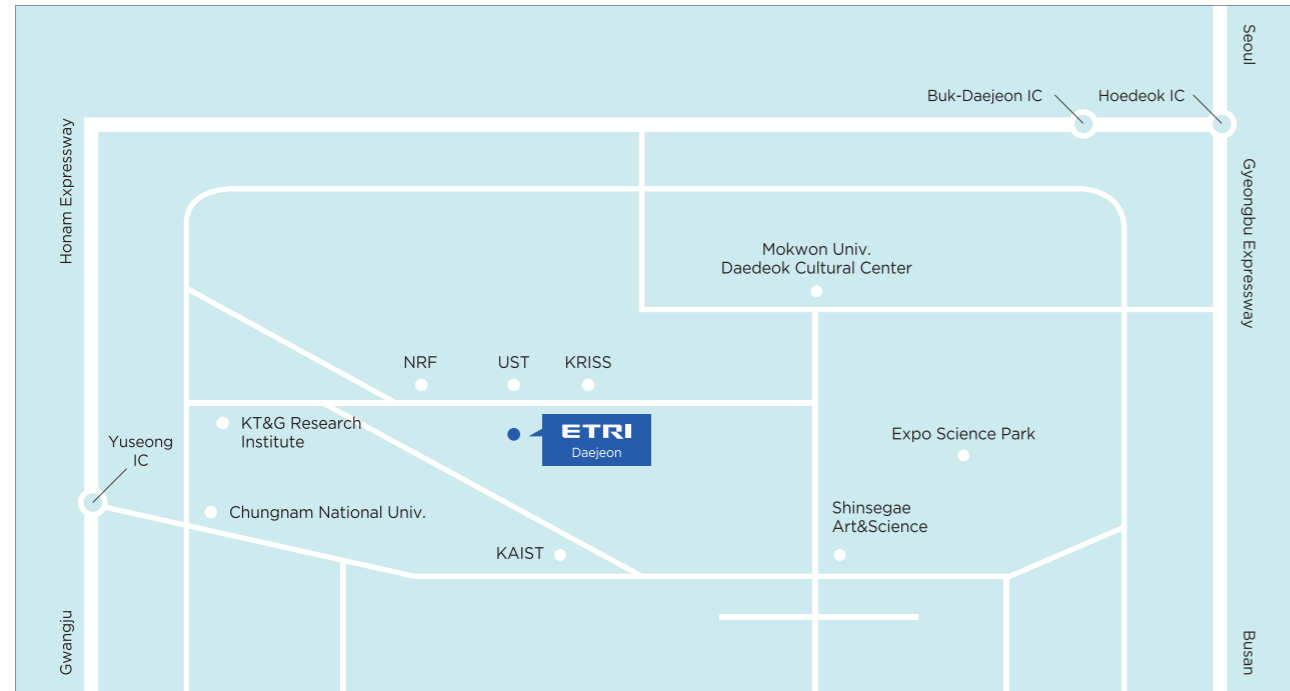
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218 Gajeong-ro, Yuseong-gu, Daejeon, 34129, Korea
Tel. +82.1466.38

Sudogwon Research Division
22, Daewangpangyo-ro 712beon-gil,
Bundang-gu, Seongnam-si, Gyeonggi-do,
13488, Korea
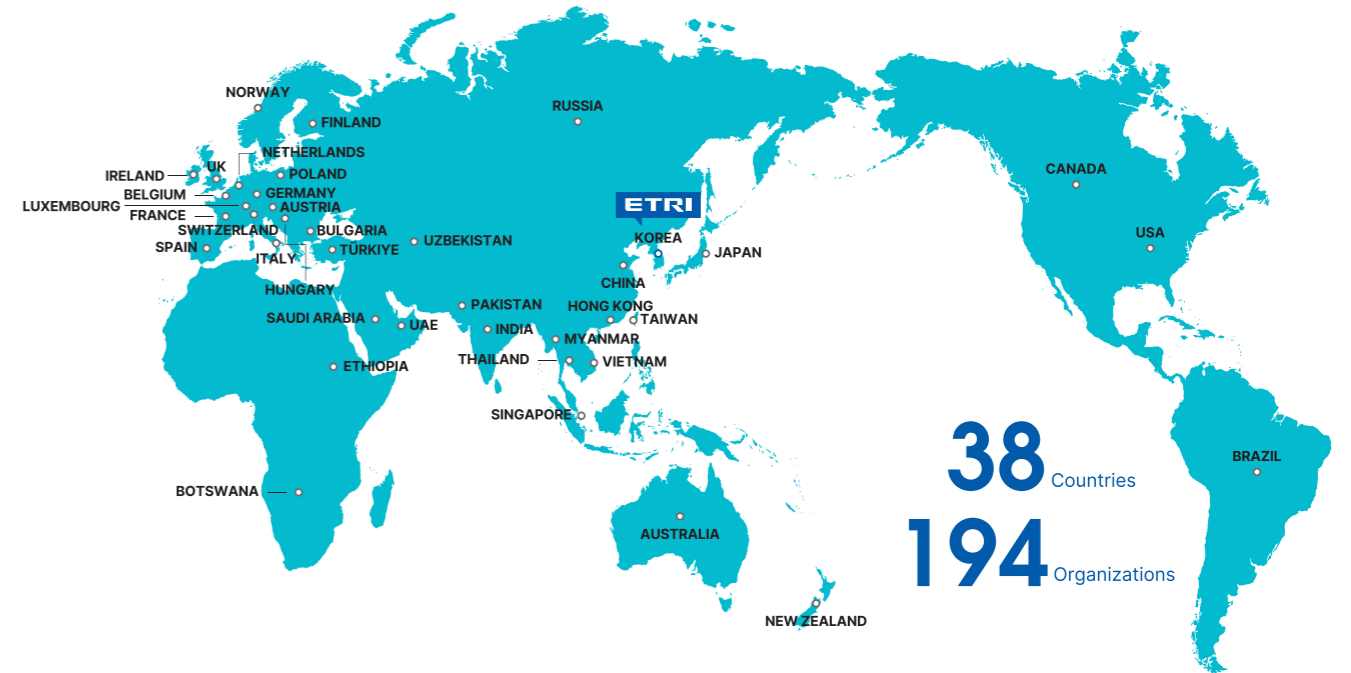Tel. +82.31.739.7200

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Tel. +82.62.970.6501

Daegu-Gyeongbuk Research Division
1, Techno sunhwan-ro 10-gil, Yuga-myeon,
Dalseong-gun, Daegu, 42994, Korea
Tel. +82.53.670.8000

Global R&D Cooperation Network

38 Countries
194 Organizations

AUSTRALIA
Distinctive Edge Support Services Pty Ltd. / Deakin University / Griffith University / University of South Australia / University of Sydney / University of Wollongong
AUSTRIA
Federal Ministry of Finance
BELGIUM
ERTICO / IMEC / University in the City of Brussels (ULB) / VRT
BRAZIL
The University of Campinas
BULGARIA
IOMT-BAS
CANADA
Communications Research Centre (CRC) / CIFAR / IBM Canada (Bromont) / MDA / QA Consultants / University of Calgary / University of Toronto / University of Western Ontario / UTIAS-SFL / Vector Institute / XANADU
CHINA
Beijing Jiaotong University / CAS SIAT / HISENSE Group Holdings / Industrial Technology Innovation Research Institute (ITIRI) / Jiangsu Provincial Department of Science and Technology / Junhe LLP / National Innovation Center-Yangtze Delta / Shanghai Jiao Tong University / Suzhou Industrial Park / TCL / Tongji University / WTOIP
ETHIOPIA
ASTU (Adama Science & Technology University)
FINLAND
AALTO / IQM Finland Oy / KC / Ministry of Economic Affairs and Employment / University of Oulu / VTT
FRANCE
Atos / Cabinet NOVACOM / CEA-Leti / CNRS / Defacto / Eutelsat S.A. / Exens Solutions / INRIA / Microlight 3D / Pasteur Research Institute / Southern Aerospace and Telecom Consulting / Syntony SAS / THALES ALENIA SPACE FRANCE
GERMANY
AIXTRON / Fraunhofer IZM / Fraunhofer-Gesellschaft / Fraunhofer-HHI / Fz-Julich / IHP / Software AG / TESATSPACE / THW / Vanguard Automation GmbH
HONG KONG
Nreal Technology
HUNGARY
Ministry of Innovation and Technology / ZalaZone
INDIA
Christ University
IRELAND
Tyndall National Institute

ITALY
ENEA / Fondazione Guglielmo Marconi / ITER IDEA / Thales Alenia Italia
JAPAN
IP bridge / KDDI / Nippon Telegraph and Telephone Corporation / RIKEN
LUXEMBOURG
SISVEL INTERNATIONAL
MYANMAR
UCSY (University Of Computer Studies, Yangon.)
NETHERLANDS
CORDIS / NLR / SMART Photonics / TNO / Wageningen Livestock Research
NEW ZEALAND
University of Auckland
NORWAY
Kongsberg Maritime AS
PAKISTAN
Information Technology University
POLAND
Poznan University / The University of Gdańsk / Warsaw University of Technology
RUSSIA
JSC APEX / Wonder Technologies
SAUDI ARABIA
AL-HALLOUL AL-MABTAKRA
SINGAPORE
AMF / Vales photonics
SPAIN
I2CAT / INSTER / NTTD ES / Semidynamics Technology Services, S.L. / Thales Alenia Space Espana / Universitat Politècnica de València / University of the Basque Country
SWEDEN
KTH Royal Institute of Technology / Uppsala University / ZnOrdic AB
SWITZERLAND
CSEM SA / ID Quantique SA / University of Bern (UNIBE)
TAIWAN
National Yang Ming Chiao Tung University / Nuvoton / TSMC
THAILAND
KMITL
TÜRKIYE
DAKIK / ERMETAL / ERSTE Software Limited / Istanbul University
UAE
TII
UK
GRAPHCORE / Airbus / Graphcore Limited / Liverpool John Moores University / Queen's University Belfast / University of Oxford / University of Surrey

USA
Ampere / ANAFLASH / ARISCALE / Avicena / California State University, Fresno Foundation / CAST.ERA / Chicago University / Columbia University / Eagle Forest / GE Licensing / General Dynamics Mission Systems, Inc. / Georgia Institute of Technology / Georgia Tech. Research Corp. / Harris / Harvard University / II-VI Coherent / Indiana University / Ingine Inc. / Intel Corporation / Interdigital, INC. / KULICKE & SOFFA INDUSTRIES, INC. / L3Harris / Mangoboost / Marconi / Microsoft / MIT (Massachusetts Institute of Technology) / NIST / Northeastern University / Northroip Grumman / Optisys / Phoenix Technologies Inc. / Power America / pSemi Corporation / Purdue University / Qualcomm / Rambus / Rutgers University / San Jose State University / Santa Clara University / SMART Global Holdings, Inc. / South Dakota State University / State University of New York / The Ohio State University / The University of Texas at Austin / TidalScale / University of California Riverside / University of California San Diego / University of Central Florida / University of Colorado Boulder / University of Colorado Colorado Springs / University of Houston / University of Portsmouth / University of Taxas at Dallas / University of Texas at Arlington / University of Washington / University of Wisconsin-Madison / US Department of Defense / Via Licensing Corporation / VIAVI SOLUTIONS / Vimmerse / Virginia Polytechnic Institute and State University / William & Marry Coulage / XILINX, INC.
UZBEKISTAN
IUT (Inha University in Tashkent) / MDT (Ministry of Digital Technologies) / MITC / TUIT (Tashkent University of Information Technologies)
VIETNAM
Hanoi Univ. of Science & Technology

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TEL +86-186-1408-8551

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ETRI by the Numbers

Industry 4.0 patents (universities / research institutes)

1st
in the world

2nd Fraunhofer	3rd UCLA	4th ITRI
5th CAICT	6th Harvard	7th KAIST
8th MIT	9th CEA	10th TNO

* Source : Patents and the Fourth Industrial Revolution (European Patent Office, 2020. 12.)

Top 100 Excellent National R&D

1st
in the country

Most single-institutional excellence achievements from 2006 to 2023 (13 out of 18)

~2018	2019	2020	2021	2022	2023
99	13	9	10	9	11
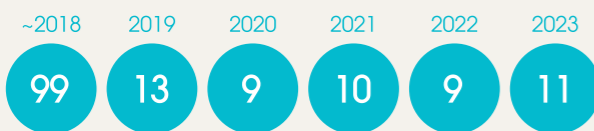
Total 151

Top 10 Applicants in AI
(Korean Intellectual Property Office)

3rd

1st Samsung Electronics	2nd LG Electronics	3rd ETRI
	4th KAIST	5th Google

* Patent Statistics for Technologies Related to the Fourth Industrial Revolution (Korean Intellectual Property Office, '20. 09.)

International Organization for Standardization (ISO, IEC, ITU) standard patents

5th
in the world

1st Samsung Electronics	2nd Nokia
3rd Thomson Licensing	4th Apple

* Press Release from the Korean Intellectual Property Office ('21. 05.)

Research productivity of major public research organizations
(including equity income)

6.7%

- ITRI (Taiwan) : **6.2%**
- Fh.G (Germany) : **5.3%**
- VTT (Finland) : **1.5%**
- Max. Plank (Germany) : **0.6%**
- AIST (Japan) : **1.4%**

* Based on 2022 data, AIST 2021 data

R&D Industry Impact

374 trillion KRW

Top 10 research achievements
248
trillion KRW

Wibro, CDMA, TDX, W-CDMA, 4K UHD, LTE/LTE-A, Terrestrial DMB, 4K UHD, OLED/AMOLED, Memory Semiconductor, Voice Recognition Automatic Translation

R&D IPR industrial impact
126
trillion KRW

* Period of analysis : 1976-2016 (40 years)

THE MAIN R&D FIELD

EMERGENCE OF SOFTWARE THAT SIGNIFICANTLY EXPANDS MEMORY CAPACITY IN SMART DEVICES

Developing software technology to increase virtual memory capacity

Koh Kwang-Won _ AI Computing System SW Research Section, Director

Artificial Intelligence Computing Research Laboratory

Constraints on hardware resources like those found in smartphones often pose challenges for new and innovative services. For instance, a smartphone with 8GB of memory struggles to run a 13GB generative AI model. Researchers are continuously working to overcome such limitations by addressing memory shortages through software solutions. This effort aims to virtually increase memory capacity as though there is an additional 5GB of memory available.

The latest Samsung smartphone, the Galaxy S24, supports up to 13 languages, providing real-time interpretation services from voice to text on the screen. With larger memory capacities, real-time interpretation services can be much smoother. This is because larger memory allows for higher quality generative AI models. However, existing smartphones face limitations due to the constraints of device memory, making it challenging to adopt new services. Researchers are actively working to address these limitations.

In reality, smartphone memory is also used for system operation, applications, and core operating systems, making it difficult to utilize the entire memory capacity for specific services. As a result, when new services requiring large memory sizes emerge, memory shortages become apparent.

The research team plans to further develop the core technology and refine the on-device application of the technology by the end of this year, aiming for full-scale commercialization next year through technology transfer to specialized companies. To solve the problem through software, they are considering additional Android memory management software or the use of separate downloadable apps.

Developing new AI models is also a crucial issue. However, even after models are developed, memory is the most critical factor for executing them within a system. On-device AI is crucial for technologies like robots and drones. Additionally, to utilize new services from specific companies, one must use the service provider's servers, which can lead to new security concerns.

This technology is expected to be primarily transferred to companies or services that utilize on-device AI, such as real-time interpretation services over the phone, automatic meeting summarization functions, laptop and desktop PC manufacturers, robot manufacturers, drone manufacturers, and smartphone manufacturers. For robots and drones, utilizing on-device AI by developers is expected to contribute to providing higher quality services. Furthermore, in a general office environment with desktop PCs, memory extension through on-device AI will make tasks like sorting and searching much easier, providing broader usability.

The core technologies of this technology include memory expansion technology, compiler technology, and on-device artificial intelligence computing software technology.

The research team described that this technology is essential for the imminent era of AI Everywhere. Recently, not only smart devices but also laptops and desktop PCs have been integrated with AI support, making AI Everywhere a reality. Once this technology is commercialized, users will be able to use smarter AI on smart devices and personal PCs anywhere without worrying about data breaches. This will eliminate the need to rely on internet-connected AI computing. Additionally, manufacturers will be able to significantly reduce the costs associated with operating AI services on the cloud, and it will help address data center energy issues caused by handling numerous AI computations exclusively in the cloud. Therefore, this technology will further accelerate the spread of AI across various industries.
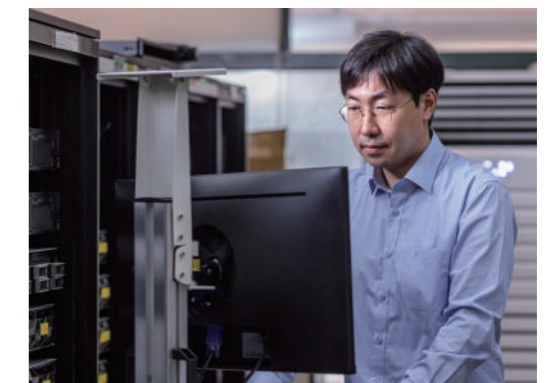
A RADAR HAS BEEN DEVELOPED TO LOCATE PEOPLE IN DARK DISASTER SITES

A high-precision radar sensor detects the vital signs of victims behind walls.

Park Pil Jae _ AI Sensing SoC Research Section, Principal Researcher

Artificial Intelligence Computing Research Laboratory

Radar has many applications. Originally, RADAR (RAdio Detection And Ranging) was an acronym for detecting and measuring distances using radio waves. It works by sending out electromagnetic waves, which bounce off objects and return, allowing the device to determine what the object is, as well as its direction, distance, and speed. Often, the term "radar" is used to refer to the radar device itself. Radar is widely used not only in defense, such as in artillery, missiles, and fighter jets, but also in ships, cars, and detection systems.

In disaster sites like fires, explosions, or building collapses, it is very difficult to dig through debris and rescue people. Researchers have developed advanced radar sensor technology to help rescuers save lives more effectively in these situations. This technology is expected to support fast and safe rescues, improving disaster response efficiency.

The researchers developed a human life detection ystem using Frequency Modulated Continuous Wave (FMCW) radar sensors and Impulse Radio Ultra-Wideband (IR-UWB) radar sensors. They created a radar capable of detecting movements as small as a centimeter using single-chip semiconductor technology.

The radar sensor technology developed by the researchers can detect movements, breathing, and heartbeats of people hidden behind walls or buried under debris, where they can't be seen.

Inside a burning building, visibility is limited due to smoke, flames, and dust. It's also hard to hear anything. If there is a wall between the person waiting for rescue and the firefighter, it's impossible to see them. Radio waves can penetrate smoke, walls, and debris, making it possible to find people in non-visible environments. When a person breathes, their chest and abdomen move, and even the tiny movements of the heart inside the body can be analyzed using radio signals, making it specialized for detecting people. The radar developed by the researchers is designed to be small and affordable, making it suitable for use in disaster sites.

If this sensor semiconductor technology is miniaturized, it can accurately locate people in need of rescue in various disaster sites like fires, explosions, and collapses, enabling quick rescues and greatly helping the safety of rescuers.

In the future, it could be attached to the helmets and portable equipment used by firefighters, assisting them in their tasks. Researchers are working on making the technology even smaller to be more convenient for firefighters to carry. They are also developing a radar that uses multiple units to improve detection performance over large disaster sites.
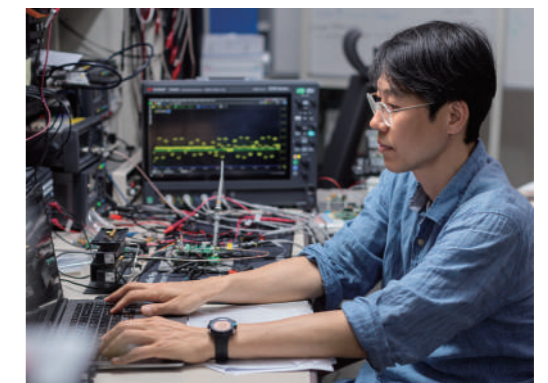
THE KOREAN VERSION OF 'MINORITY REPORT' BECOMES A REALITY

Developing cutting-edge crime prediction security system with AI-powered CCTV

Kim Geonwoo _ AI Convergence Security Research Section, Principal Researcher

Artificial Intelligence Computing Research Laboratory

The research team has succeeded in developing a technology that combines CCTV with artificial intelligence to predict signs of crime in advance, evolving from surveillance to a crime prevention tool. It's akin to a Korean version of the 'PreCrime system' from Minority Report. The technology developed by the research team is called 'Dejaview.'

In advanced countries like the United States and the United Kingdom, there has been a shift from post-crime response to a predictive policing paradigm focused on crime prevention. Now, it seems that this technology will evolve into a new advanced social safety system by analyzing and combining artificial intelligence CCTV technology with crime statistics and location information.

The Dejaview technology developed by the research team focuses on the tendency for similar patterns of crime types, methods, locations, and durations to repeat. In other words, it is an AI technology that measures and predicts the risk of crime by comparing and analyzing past crime situations with current ones. When abnormal situations like continuous stalking are detected, the AI-enabled CCTV starts tracking. Simultaneously, it compares and measures the similarity between the current situation and past crime statistics to identify the risk of crime occurrence. Based on crime big data, it automatically analyzes the current situation in CCTV to probabilistically predict the type and likelihood of crime occurrence. If a situation unfolds in a location late at night, especially where a crime previously occurred, and it shows a similar pattern to past crimes, the risk is considered very high.

If it's determined that a person following is covering his/her face with a hat or mask, or carrying a weapon, immediate notification can be sent to the police. The research team trained various AI models by analyzing over 20,000 criminal case records to enhance prediction accuracy, then piloted them in Seoul's Seocho-gu district.

The trained AI automatically analyzes real-time CCTV footage to predict the type and risk level of potential crimes within minutes to hours. The team plans to enhance the technology further by adding features such as 'person re-identification technology'(multi-CCTV-based continuous tracking of specific individuals) to enable AI to identify the move-ment paths and risk behaviors of high-risk groups such as sex offenders and immediately locate them using nearby CCTV. They are also developing technology to detect and analyze sounds like footsteps and assess attributes such as gender, age group, accessories, carried items, etc. on the screen to increase prediction accuracy. To address privacy concerns, they apply personal sensitive information protection technologies, such as obscuring or blurring faces of individuals without criminal records in the video for analysis. This intelligent CCTV technology developed by the research team is currently operational or in the final stages of service provision in public institutions such as the Sejong City Urban Integrated Information Center. The crime prediction map jointly developed with Seoul's Seocho-gu district, based on the analysis of over 32,656 CCTV incidents and accidents from 2018 to 2021, indicates areas with a high probability of crime occurrence, demonstrating a prediction performance of 80.9% according to TTA performance test standards.

While traditional CCTV systems mainly provide evidence of crimes after they occur, the technology currently under development, when combined with AI, will operate as a future advanced societal safety system capable of predicting and preventing the likelihood of crime occurrence.
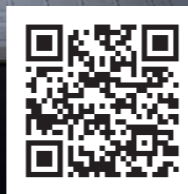
CREATING A KOREAN VERSION OF 'DALL·E'

Development of image-generating AI technology…
Writes a sentence and creates a photo in just 1 seconds

Youngwan Lee _ Visual Intelligence Research Section, Senior Researcher

Please scan the QR code
to watch the interview video.

Superintelligence Creative Research Laboratory

Recently, Chat GPT, or Generative Artificial Intelligence (AI), has gained significant popularity. It is an AI that generates new content or ideas, including conversations, stories, images, videos, and music. Generative AI technology has garnered considerable attention for its ability to engage in conversations with humans. With the recent release of ultra-fast generative visual intelligence models, there is expected to be a surge in related research activities.

Researchers have unveiled a technology that can generate a photo (image) in just 0.83 seconds after entering a sentence. It's as if a Korean version of DALL·E is born at lightning speed. When you input a sentence like "an astronaut riding a horse on the moon," a related image appears in the blink of an eye. It's an image-generating AI model that creates pictures corresponding to the input sentence. It took 3.8 seconds for Karlo (Kakao Brain), 12.3 seconds for DALL·E 2 (OpenAI), and 13.7 seconds for DALL·E 3 (OpenAI).

This technology is not only ten times faster than OpenAI's DALL·E 3 but also produces high-resolution images. By applying knowledge distillation techniques, the artificial neural network size has been dramatically reduced to 700 million parameters. The size was reduced to about 28% from the previous 2.5 billion parameter count. Since a large number of parameters require extensive computation time and increase operational costs, this technology does not require thousands of servers. It combines generative artificial intelligence and visual intelligence technology.

Researchers have identified a problem with existing publicly available technologies : they can produce high-quality images but are slow. They have named the image-generating AI 'KOALA.' The key is to make the super-large neural network model lighter to produce images faster. Moreover, the reduced artificial neural network size means it does not require thousands of servers. It can even run on low-cost Graphic Processing Units (GPUs) with as little as 8GB of memory. This puts it in a superior position in terms of price competitiveness.

The developed 'KOALA' 3-model series has been released on HuggingFace[1].

Additionally, researchers have developed technology that can describe videos. Users can engage in conversations with AI, asking for additional information while discussing. After making this technology publicly available, researchers plan to transfer the technology to image generation services, creative education services, content creation, and business operators.

Researchers plan to lead global research efforts in generative AI beyond the type that connects sentence input to sentence response to types that respond to sentences with images or videos and vice versa.

The reason for researchers to release this model is to lower the inference costs associated with large models, thereby enabling small and medium-sized enterprises to utilize it and fostering growth in the relevant market ecosystem.

1) https://huggingface.co/spaces/etri-vilab/KOALA

THE ROBOT DETECTS THE FRESHNESS OF TOMATOES THROUGH ITS SENSE OF TOUCH

Intelligent robot gripper technology successfully distinguishes 98.7% of 11 types of tomatoes

Hye Jin Kim _ Intelligent Components and Sensors Research Section, Principal Researcher

Please scan the QR code
to watch the interview video.

Superintelligence Creative Research Laboratory

The research team has developed a robotic hand that can sense touch like a human's hand using artificial intelligence. It can grasp objects, assess their properties, and control them with appropriate force. This technology not only enhances the future of robotics but also has promising applications in various industries such as transportation, healthcare, manufacturing, and space.

The gripper, a tool resembling a human hand, holds a tomato gently, lifts it carefully, and moves it to another location without causing damage. As the gripper holds the tomato, its size, shape, and firmness are instantly measured. The intelligent gripper successfully distinguished between 11 different types of tomatoes with 98.78% accuracy, even detecting the ripeness of tomatoes in real-time. This technology is particularly impressive as it demonstrated stable operation through more than 10,000 repetitions of experiments and under adverse conditions such as low temperature and high humidity.

In everyday life, we can assess whether vegetables or fruits are ripe or firm by pressing them with our hands. Similarly, by utilizing a flexible multi-modal tactile sensor, we can accurately determine the initial size, shape, and properties of objects and effectively control them. The intelligent robot gripper actively understands what object it is gripping using the flexible multi-modal sensor and determines the moment to stably grasp the object. Moreover, it adjusts the gripper's force (torque) accordingly, providing feedback.

The core technology involves fine adjustments between the detection material and electrodes, known as 'air gaps,' allowing simultaneous detection of pressure applied to objects and the degree of gripper bending. In addition, this also enables precise assessment of the firmness of objects. The sensor exhibited extremely stable performance even after more than 10,000 repetitions of pressure and bending tests, as well as validation

of reliability in low-temperature and high-humidity environments.

Key technologies include a large-area flexible multi-modal sensor integration platform, an air gap-based flexible multi-modal(pressure/bending) sensor, an artificial intelligence algorithm model for discriminating object size, shape, and properties, and tactile feedback control technology for the robot gripper.

The multi-modal tactile sensor developed by the research team can endow robotic grippers with various tactile functions, making them versatile for future applications in automated lines, collaborative robotics, and service robotics. The team plans to integrate various sensors, including temperature and humidity sensors, inertial sensors, and distance sensors, into a single platform. Additionally, they aim to develop a flexible, stretchable multi-modal artificial skin with a variety of integrated sensors for the robot gripper, enabling rapid and natural movements akin to human hands.

THE DEVELOPMENT OF NOBLE SEMICONDUCTOR MATERIALS SIGNIFICANTLY REDUCES POWER CONSUMPTION BY 95%

The traditional semiconductor packaging process, which used to consist of 9 stages, has been reduced to just 3 stages with the world-first development of film-based new materials.

Choi Kwang-Seong _ Low-Carbon Integrated Technology Creative Research Section, Director

Superintelligence Creative Research Laboratory

Research team succeeds in reducing the process steps from 9 to 3 by developing noble semiconductor materials for laser-based process, saving 95% of power compared to Japanese technology. This technology, which reduces power consumption by 95% compared to Japanese technology, is expected to be used in manufacturing technologies to implement high-performance Artificial Intelligence(AI) semiconductors such as autonomous driving and data centers.

The research team has succeeded in developing original materials in the semiconductor packaging field. Semiconductor packaging is a process where individual integrated circuit components manufactured on a wafer are separated and assembled into modules.

In the semiconductor industry, advanced semiconductor packaging processes have been using Japanese materials. However, the process required a total of nine steps, and there were drawbacks such as high power consumption, maintenance costs for semiconductor clean rooms, and emission of hazardous substances. Global companies have been accelerating the development of nanometer-scale high-performance chips, but there were limitations such as the impossibility of interconnection below 40μm for chiplet integration technology which give the economic feasibility to the advanced semiconductor wafer fabrication.

After about 20 years of core technology research, the research team has succeeded in creating a 'extreme power-saving semiconductor chiplet packaging' technology. Chiplet means separating high-performance chips by function. which increases yield and lowers the cost of advanced semiconductor manufacturing. The developed process starts by applying film materials, developed using nano technology, to advanced semiconductor wafer substrates. Subsequently, the tiles made of chiplets produced on various wafers are assembled by shooting lasers for 1 second to complete the bonding process, followed by a curing process.

The original material developed by the research team is used to fabricate polymer film. This material, which is a 10-20 μm thick epoxy-based material with a reducing agent added, replace all steps; reflow, cleaning, drying, plasma treatment, and underfill dispensing in the semiconductor packaging process when a laser is applied. As a result, the existing 9-step process has been reduced to 3 steps. In particular, thanks to the developed material, it is possible to directly attach chiplets to wafer substrates like sticking tiles. This technology simplifies the process, reducing the entire production line from over 20m to 4m. There is also an advantage of no emission of harmful substances and nitrogen gas is not required. For Japanese technology, if 100 units of power are used, this technology only requires less than 5 units of power.

Furthermore, in order to develop high-precision processes, the research team has achieved the world's first integration process on the stage with 25°C (room temperature). Previous processes all heated the stage to around 100°C, resulting in increased power consumption and reliability degradation due to thermal expansion. The research team has developed world's first original materials and methods that allow integration processes on room temperature stage without fume generation caused by temperature rise. The research team explained that this technology is currently being evaluated for processability and reliability by collaborating with micro LED-related startups in the United States as well as world-renowned foundry company in the advanced semiconductor field. Commercialization is expected within the next 3 years.
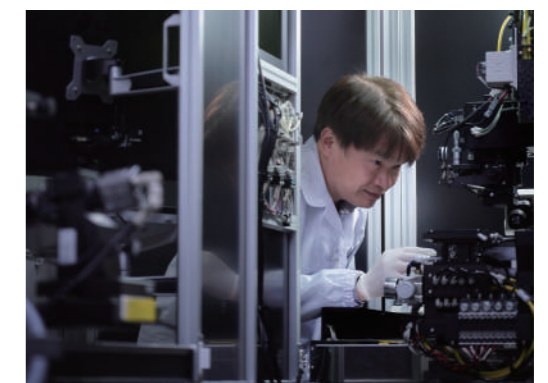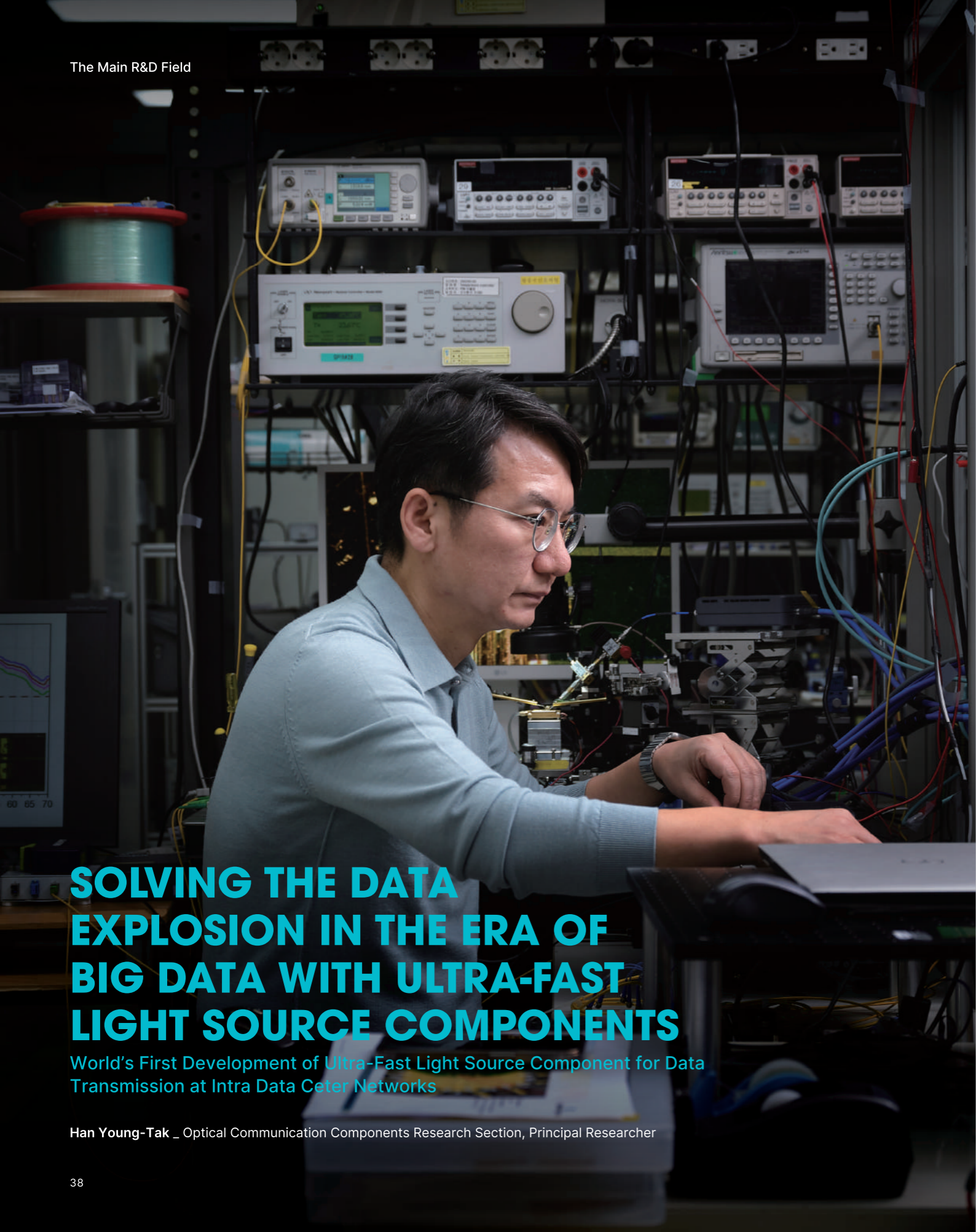
SOLVING THE DATA EXPLOSION IN THE ERA OF BIG DATA WITH ULTRA-FAST LIGHT SOURCE COMPONENTS

World's First Development of Ultra-Fast Light Source Component for Data Transmission at Intra Data Ceter Networks

Han Young-Tak _ Optical Communication Components Research Section, Principal Researcher

Terrestrial & Non-Terrestrial Integrated Telecommunications Research Laboratory

Recently, with the advancement of artificial intelligence technology, along with Virtual Reality (VR), Augmented Reality (AR), and Over-The-Top (OTT) services providing internet-based video, there has been a significant increase in data usage. This surge in data usage and consumption has led to challenges in managing and providing data storage and transmission through data centers and mobile communication base stations. Consequently, technologies that efficiently manage and enhance data transmission speeds have become one of the most crucial technologies in modern society.

In response to this, researchers have developed a groundbreaking technology to address the surge in data usage, leading the way in carbon reduction and ESG (Environmental, Social, Governance) management. This technology involves the use of high-speed light source components to significantly increase data transmission speeds, effectively tackling the issue of data explosion. With this technology, it is possible to send more than 5GB of Ultra-High-Definition (UHD) movies in just one second.

The high-speed light source component is designed for use in optical transmission and reception (transceiver) modules within data centers operated by major portal companies such as Google, Naver, and Daum. It serves as a crucial component for high-speed optical communication within data center servers. Compared to the previous maximum transmission speed of 100Gbps per channel, this technology has more than doubled the speed to 224Gbps. Additionally, the transmission capacity of optical transceiver has increased fourfold, from 400Gbps to 1.6Tbps. Previously, the speed for sending a 5GB Full HD movie was limited to one per second, but now it is possible to send 5.6 movies per second. As a result, with more than a twofold increase in transmission speed per channel and a fourfold increase in the overall optical transceiver module's transmission capacity, data centers can maintain their capacity without the need for expansion, thus reducing maintenance costs.

Moreover, the researchers have developed this technology to withstand high temperatures, making it possible to achieve transmission speeds of up to 224Gbps even at 70°C. This breakthrough opened the way to solve the problem of deterioration in the performance of light source component due to high heat generated during data center maintenance.

The ultra-high-speed light source chip developed by the researchers can be used in the Intra data centers to transmit 224Gbps optical signals per channel and is ultra-small in size, less than a millimeter (0.2mm x 0.85mm). This chip contains the world's first integrated optical mode converter (or spot-size converter) and monitoring photo-detector. By consolidating these components into a single chip, efficiency is increased, and costs are reduced. This shift from module-centric research and development to chip-based foundational technology acquisition has paved the way for domestic optical component companies to enhance their global competitiveness.

The global market size for optical transceiver modules is expected to reach $18 billion in 2026. The researchers transferred the technology to a related company in December 2023, and plan to dominate the global market through commercialization in the future. Additionally, they filed domestic and international patents and will support domestic companies with continuous technology transfers to compete with global corporations.
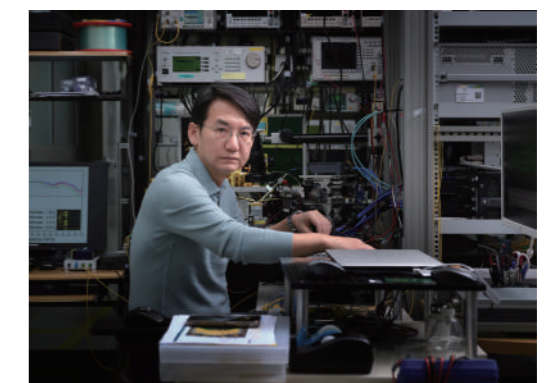
5G SMALL CELL BASE STATION ENABLES GIGABIT SPEED COMMUNICATION ANYTIME, ANYWHERE

successful development '5G Small Cell Base Station' commercial SW achieving 3Gbps speed

Jeehyeon Na _ Intelligent Small Cell Research Section, Director

Please scan the QR code to watch the interview video.

Terrestrial & Non-Terrestrial Integrated Telecommunications Research Laboratory

In industrial settings such as smart factories, 5G networks are essential, but their short transmission distance and expensive base station installation costs have limited their use by on-site users. Researchers have succeeded in developing the '5G Small Cell Base Station SW,' which utilizes two different frequencies simultaneously to establish dual connectivity. This achievement represents a world-class small cell base station speed. In 5G private networks like smart factories, smart homes and military network, Gigabit-speed communication (Gbps) is expected. With this advancement, 5G communication becomes feasible in cost-effective manners without communication dead zones.

This enables the simultaneous use of mid-frequency band and high-frequency band (mmWave) in base stations, resulting in download speed of up to 3Gbps and upload speeds of up to 800Mbps. Approximately 300 users can simultaneously access the video streaming service and downloading a full HD movie takes just one second. Not only does this improve transmission speeds, but it also reduces the load on base stations. This advancement is expected to be particularly useful in environments like 5G private networks established within certain regions for specific purposes, such as military or industrial applications.

Within the military domain, real-time video streaming from tank to tank or from tank to command post can be realized. In industrial settings like smart factories, it enhances convenience by enabling real-time communication and management using robots. Establishing a 5G private network for implementing indoor autonomous robots becomes more efficient with this technology.

In contrast to macro cell base stations, the service area of small cell base stations is relatively small, but they can be easily installed anywhere using relatively tiny equipment (about the size of a tablet PC). It takes advantage of both mid-frequency and high-frequency band simultaneously, significantly improving transmission speeds from the user's perspective. Additionally, the ability to freely adjust uplink and downlink is achieved, contributing to the realization of 5G private network goals.

This technology not only demonstrates technological superiority in terms of transmission speed but also proves the effectiveness of utilizing mmWave frequencies for high-speed transmission after the commercialization of 5G. Furthermore, it offers significant cost savings for establishing 5G private network. This achievement plays a significant role in cost-effectively distributing data for network operators.

With the ability to utilize mmWave frequencies using only 5G technology and achieving a maximum transmission speed of up to 3Gbps, successful software development has enabled high performance at low costs. Consequently, the utilization of mmWave small cells is greatly enhanced, promising wide applications in high-definition services, mobile broadcasting, high-definition CCTV services, smart factories, and beyond.

WORLD'S FIRST SUCCESS IN WIRELESS COMMUNICATION THROUGH SOLID ROCK, PENETRATING 40M

Opening the Path for Wireless Communication in Mines and Underwater... Expectations for Future Search and Rescue Operations

Cho In Kui _ EM Wave Basic Technology Research Section, Principal Researcher

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Terrestrial & Non-Terrestrial Integrated Telecommunications Research Laboratory

Developing technology for communication in extreme environments such as underground mines, tunnels, and deep water areas has always been challenging due to the limitations of traditional wireless communication methods. However, researchers have made significant strides in this area by pioneering wireless communication technology capable of transmitting and receiving voice signals even in the harsh conditions of a 40-meter underground limestone mine.

Traditionally, wireless communication has been deemed impossible in such environments due to the complexities of the terrain, signal attenuation, and the inability of conventional communication signals to penetrate through solid rock formations. This posed significant challenges, especially in emergency situations such as mine collapses, where rescuing trapped individuals or determining their whereabouts became exceedingly difficult.

The research team has developed a 'magnetic field underground communication technology' for the first time in the world, which allows for the transmission and reception of voice signals 40 meters underground in a limestone rock mine. Utilizing the magnetic near-field, we installed a 1-meter diameter transmitting antenna and a several centimeters receiving antenna at the top and bottom of the underground, achieving the transmission of text data at 4kbps, which is equivalent to voice signal transmission levels, using a 20kHz band carrier wave. They have developed this new communication system by utilizing the unique boundary conditions of the magnetic field relative to the medium.

In this innovative system, the transmitter antenna functions akin to a communication relay station(AP), facilitating the connection between the surface and underground areas, while the receiver antenna detects and interprets the transmitted signals in real-time. By exploiting the unique boundary conditions of magnetic fields in the medium, the research team devised a new communication system that overcomes the limitations of conventional electrical field-based transmission methods.

Unlike conventional electromagnetic waves, which suffer from significant propagation losses when passing through dielectric materials, magnetic fields offer a more robust and loss-independent transmission medium. This breakthrough opens up new possibilities for wireless communication in challenging environments, enabling reliable voice communication and potentially extending to data transmission applications.

Looking ahead, the researchers aim to further enhance the technology by extending the transmission range to over 100 meters, increasing data capacity, and reducing the size of the equipment. This advancement holds promise not only for improving safety and rescue operations in mining and underground emergencies but also for applications such as underwater resource management and underground infrastructure maintenance. The success of this groundbreaking technology is attributed to over a decade of research and development efforts focused on wireless power transmission fundamentals.

Hyper-Reality Metaverse Research Laboratory

Broadcast media and content technology is one of the closely intertwined technologies with our daily lives. With the advancement of media technology applied to TVs, displays, smartphones, etc., accessing broadcasts has become easier anytime and anywhere.

CREATING VIRTUAL HUMANS TO RESEMBLE REAL HUMANS

Developing technology for enhancing the realism of digital human

Lee Seung Wook _ Spatial Content Research Section, Principal Researcher

A technology that transforms computer-generated virtual humans into lifelike individuals has been developed. Through Artificial Intelligence technologies, real-time transformations are achievable. The enhanced vividness of the broadcasting world is eagerly anticipated. This technology was utilized in Arirang TV's global audition program 'Code Name Busan'.

The technology developed by researchers has made its way into live TV broadcasts. When the screen transitions, computer-generated moving virtual humans transform into real individuals, mimicking their movements in real-time. The content technology developed by researchers has gained recognition worldwide.

The realism enhancing technology of digital human developed by researchers is remarkable. It transforms digitally created humans of medium to low quality into lifelike digital humans. This technology upgrades low-cost digital humans to high-cost and high-quality ones. The researchers succeeded in overcoming technological limitations to achieve enhanced resolution and realism in live broadcasting. In collaboration with Pulse9 Inc., a research institution, Deep Real Live technology incorporating face-swapping for realistic visualization was applied.

This technology applies generative artificial intelligence-based realistic visualization. Learning from numerous photos enables natural transformations. Particularly in the process of converting videos, any slight discrepancies like 'jitter' that were somewhat awkward have been rectified, allowing for real-time usage. This means that digitally rendered, unnatural digital human videos can be transformed into indistinguishable ones using Artificial Intelligence technology.

Researchers have applied the lifelike digital human technology to kiosks serving as information desks, soon to be commercialized. Moreover, its application is highly anticipated in various industries such as education, broadcasting, shopping, and movies, where digital humans appear. Researchers plan to further study the technology to transform not only faces but also arms, legs, and other body parts like real individuals.

In the future, it is anticipated that movies featuring virtual humans created with 3D graphics instead of actors or movies with humans transformed into animations will become possible. Furthermore, with the recent introduction of UHD broadcasting equipment systems by broadcasting companies, various content productions utilizing digital humans are expected. Recently, researchers have been developing generative AI technology that can be applied across the entire content area, leading the related technologies and industries with practical applications.

REBIRTH OF ANCESTORS' CULTURAL HERITAGE IN THE DIGITAL REALM

'The Pensive Bodhisattva' and 'Gwanggaeto Stele'
Come to Life Before Our Eyes

Jae-Ho Lee _ Content Convergence Research Section, Principal Researcher

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to watch the interview video.

Hyper-Reality Metaverse Research Laboratory

Digitization of globally significant cultural heritage, artifacts, and relics, including those with historical significance, is actively underway worldwide. In South Korea, researchers, including experts from the National Museum of Korea, are breathing new life into national treasures using digital technology.

Digitizing historical cultural assets that have existed for centuries or millennia is no easy task. It involves processes such as creating data for cultural assets, structuring data, converting it into a database (DB), and designing metadata to ensure effective operation on platforms tailored to user needs. Only through these processes can the future utilization, reuse, and preservation of content become possible.

Researchers in South Korea are creating 2D and 3D data for our cultural heritage, standardizing data quality, and striving for metadata standardization that can effectively represent the data. Currently, there are over two million digitized cultural heritage items, but not all of this vast amount of data is automatically searchable or usable in other fields.

To make digital cultural heritage more accessible, researchers are focusing on securing artificial intelligence-based technologies. The goal is to make digitally preserved cultural heritage easily and conveniently usable for any purpose in the future.

As a prime example, researchers have installed media wall contents for the 'The Pensive Bodhisattva' at Incheon International Airport Terminal 1 and 'Gwanggaeto Stele' at the lobby of the National Museum of Korea, receiving significant acclaim. They have also held joint content exhibitions at the Cleveland Museum in the United States, garnering praise. Notably, the 'The Pensive Bodhisattva' exhibited at the National Museum of Korea won the German IF Design Award (2023), and the 'Pyeongsaengdo,' embodying the dreams of Joseon people, was selected as a Red Dot Award winner (2023), validating the excellence of the technology.

The artificial intelligence-based cultural heritage data analysis technology developed by the researchers involves creating archives based on data fabrics and analyzing cultural heritage with artificial intelligence. They aim to share platforms for various stakeholders through digital heritage standards and AI-based data expansion. This effort is expected to create an intelligent digital heritage sharing platform widely used not only for artifact management in museums but also for the preservation research, immersive realistic content, interactive cultural education, and more.

The new data created by the researchers is being meticulously digitized to significantly enhance the usability of the data. Additionally, they have centralized the preservation, exhibition, video data, 3D data, etc., making the platform easily searchable. Through this, people can easily find and utilize the data anywhere, anytime, and it can also be used in digital twins or metaverse environments. Expectations are high for its future use in commercial advertising, 3D products, and more.

In the future, the researchers plan to spread the ripple effects of standardizing domestic cultural heritage data to the global stage. They aim to promote its expanded adoption in the curation of overseas museums. The researchers are further exerting efforts to spread K-cultural heritage technology following the success of K-pop and K-dramas.

SECURING NEXT-GENERATION FUNDAMENTAL TECHNOLOGIES FOR AI VIDEO PROCESSING

Feature Coding Technology for Machines Achieves Top Position at MPEG Standardization Meeting

Lee Jin Young _ Immersive Media Research Section, Principal Researcher

Hyper-Reality Metaverse Research Laboratory

The videos we watch every day are the result of the diligent efforts of researchers. Video content becomes viewable only through the processes of compression, encoding, and decoding. As video resolution increases, the size of the content also increases, making these processes more complex. Over the years, researchers have developed technologies related to content compression, leading them to international standards and enabling people worldwide to watch high-quality videos using our technologies.

For the past 30 years, video compression has primarily targeted 'humans,' advancing video encoding technologies to minimize the impact on human visual quality and achieved compression ratios ranging from 50 to up to 400 times through standardized technologies.

Now, researchers have adopted a new approach, focusing on video coding for 'machines' instead of humans. With the advancement of technologies such as CCTV and autonomous vehicles, there has been an increasing amount of video processing done by machines, from identifying problematic scenes, finding suspects, to decision-making in autonomous driving scenarios. Machines now frequently receive and process video without human intervention, especially as video data explosion on networks demands more data processing and compression.

At the MPEG standardization meeting, the research team ranked first and second in the evaluation of the proposed technology for 'Feature Coding for Machines (FCM).' This technology aims to efficiently process video data for artificial intelligence-based video recognition, such as autonomous driving and robotics. It compresses feature information required for performing machine tasks, reducing data volume effectively.

The technology proposed by the research team is expected to become an essential tool for machine-based video analysis with the advent of the era of machine-based video processing using deep learning networks. The technology features the fusion and reorganizing of feature maps from deep learning networks, suitable for video encod-

ing. Compared to existing video encoding technologies (VVC), it achieves over 92% performance improvement.

The technologies proposed by the research team are expected to be reflected in a reference software for future international standardization efforts, giving domestic researchers an advantage in international standard adoption. The team plans to continue efforts to establish these technologies as the foundational elements of international standards for next-generation encoding.

As machine learning-based video processing increases and intelligent platforms such as autonomous vehicles and smart cities expand, the demand for video data processing technologies for machines, rather than humans, will increase. The developed feature coding technology for machines is crucial for effectively compressing various video data between machines, assisting in the technological development and commercialization efforts of relevant domestic agencies, and is essential for the future era of machine-based video analysis.
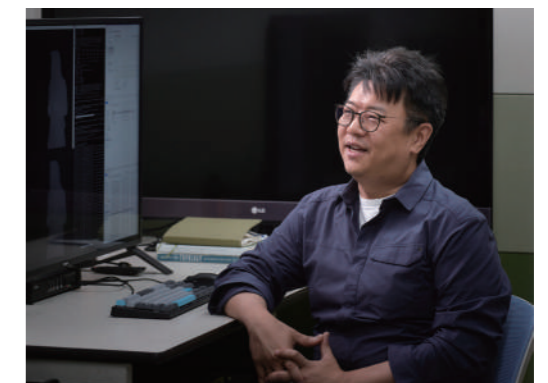
ARE FACTORIES GOING ON AN ENERGY DIET?

Development of the world-class standard Factory Energy Management System (FEMS) platform

Marie Kim _ Environment ICT Research Section, Principal Researcher

Please scan the QR code
to watch the interview video.

Digital Convergence Research Laboratory

Energy efficiency and carbon emission reduction have become global concerns. Achieving carbon neutrality is closely related to recent ESG management. A research team has developed advanced technology to lead the way for industrial sites to achieve carbon neutrality by 2050.

The team has developed a world-class open and scalable standard platform to support Factory Energy Management Systems (FEMS) throughout the lifecycle of the platform. FEMS utilizes Information and Communication Technology (ICT) to monitor, analyze, and control energy usage in factories in real-time, aiming to improve energy efficiency and conservation.

With the global consensus on climate change response and the expectation that carbon regulations will impact future manufacturing competitiveness, the importance of FEMS is growing rapidly. However, the adoption of FEMS in domestic manufacturing companies is still lacking. Small and medium-sized enterprises feel burdened by the cost of FEMS adoption, while large corporations face limitations in customizing FEMS solutions.

The standard FEMS platform developed by the research team not only makes it easy for domestic manufacturing companies to apply and utilize but also provides the most extensive functionalities in the country. The platform offers services in five categories : energy facade for holistic energy information monitoring and management, energy lens for optimizing detailed processes and facilities, energy maestro for integrating with other systems and external markets, energy guardian for anomaly detection and fault management of FEMS systems, and energy fairground for purchasing FEMS products and creating new services.

Additionally, the research team has developed five diffusion models for various forms of energy management to support different types of businesses : distributed, basic, advanced, specialized, and integrated. Companies wishing to utilize the ETRI standard FEMS platform can choose a diffusion model according to their energy management needs.

ETRI has built around ten demonstration sites of major factories, from electronic component manufacturers to health food producers, for each of the five diffusion models to verify the developed platform's technological capabilities. Moreover, the team has made efforts to standardize FEMS domestically and internationally and has been approved as a new standard item by the International Telecommunication Union's (ITU-T) International Environmental and Climate Change Study Group (SG5).

The research team and its collaborators have succeeded in developing the standard FEMS platform based on various technologies such as wireless networking, edge gateway, real-time time-series database construction, and data integration, thermal energy management, and AI and big data analysis.

This FEMS standard platform represents a representative industrial platform technology that converges various technologies in energy, ICT, and engineering. The team plans to focus on further commercialization and model development to contribute to energy efficiency businesses.

The research team will continue its efforts to address the cost concerns of FEMS adoption by domestic manufacturing companies and ensure continuous improvement and operation after adoption, aiming for continuous research and development and commercialization of digital energy infrastructure to promote the widespread adoption of the platform.

DIGITAL TWIN TECHNOLOGY TAKES RESPONSIBILITY FOR UNDERGROUND UTILITY TUNNEL SAFETY

Digital Twin Platform for Early Prediction and Preemptive Response to Underground Utility Tunnel Fire Disasters

Woo-Sug Jung _ Disaster & Safety AI Convergence Center, Director

Please scan the QR code
to watch the interview video.

Digital Convergence Research Laboratory

In urban underground areas, there are Utility Tunnel containing various urban infrastructure such as electricity, communication, and water supply facilities. These Utility Tunnel, enclosed underground, pose a risk of significant damage and make disaster response challenging when accidents occur. To address this issue, researchers have developed a digital twin platform for disaster safety management that enables early prediction and preemptive response to disasters in Underground Utility Tunnel.

In 2018, a fire of unknown origin occurred in an underground communication space near the KT Ahyeon Office in Seoul, causing disruptions not only in Seoul but also in some areas of Gyeonggi Province, affecting communication, internet, and card payment functions. This incident provided significant lessons and resulted in substantial damages.

To manage disaster safety in Underground Utility Tunnel, the research team applied 'digital twin' technology. They implemented the internal facilities of the joint space as a twin on a computer, allowing analysis of potential situations, prediction of results through simulations, and resolution of issues. Real-time information collected is used to notify control centers of anomalies in Utility Tunnel and to respond promptly to disaster situations.

The AI rail robot developed by the research team monitors seven environmental factors in real-time, including temperature, humidity, oxygen, and carbon dioxide levels, and detects signs of abnormalities such as flames, smoke, and high temperatures. Equipped with full HD and thermal cameras, the AI robot provides unmanned patrol services for detecting information. Additionally, devices for collecting eight types of environmental and video information are installed at regular intervals inside the Underground Utility Tunnel.

Previously, it took over two hours for specialized personnel to inspect the facilities and equipment in Underground Utility Tunnel. Now, robots installed in the patrol at a speed of about 10 meters per second along the rails, completing patrols within approximately 30 minutes. In the event of a fire during unmanned patrol services, the AI rail robot quickly moves to provide early response capabilities, including firefighting functions. This comprehensive disaster safety management system is fully equipped for effective disaster response.

The research team can now analyze on-site information from the underground utility tunnel and predict potential damage by conducting simulations of disaster scenarios in a virtual space when dangerous situations are detected. Through simulated experiments assuming disaster situations in virtual Underground Utility Tunnel, the research team can predict damages more accurately. Sharing real-time situational information with relevant agencies enables the establishment of an effective disaster response system. Understanding how disasters spread in virtual spaces allows for effective real-world responses based on pre-knowledge.

The research team is currently conducting pilot operations of the disaster safety management digital twin platform in Underground Utility Tunnel in Cheongju, Chungcheongbuk-do. With a total of approximately 11.18 billion won in commercialization achievements through public-private partnerships, the team plans to apply the developed technologies to field operations by the end of this year. They continue their research efforts to further advance and stabilize technologies for the safety and well-being of the public.

The research team anticipates that this technology can be applied in the future to more intelligently manage the safety of underground facilities, such as subways, underground shopping centers, and industrial sites.

USING ARTIFICIAL INTELLIGENCE, NARCOTICS DETECTION HAS ACHIEVED A 95% ACCURACY RATE

A multi-dimensional multi-modal olfactory intelligence(Deep-Nose) technology has been developed.

Chang-Geun Ahn _ Digital Convergence Research Planning Team, Director

Please scan the QR code
to watch the interview video.

Digital Convergence Research Laboratory

With the recent normalization of drug-related crimes, there has been a heightened interest in narcotics. However, detecting various narcotics in diverse environments is challenging. Distinguishing narcotics visually or solely based on smell or appearance is exceedingly difficult for anyone other than trained experts.

Researchers have succeeded in mimicking human olfactory receptors to detect illegal narcotics with an accuracy of 95%. They applied a novel artificial intelligence technique to drug detection, which yielded significant results. The pioneering technique analyzed by the researchers involves using AI to analyze the entire time-series response pattern across all stages of the sensor's gas exposure.

The electronic nose (e-Nose), initially developed for early lung cancer diagnosis using breath analysis, detects odors using an electronic device. It senses specific odor components and converts them into electrical signals for data collection. By analyzing over 800 gases emitted from human organs, the e-Nose technology diagnoses cancer.

In the recent development of narcotics detection using the e-Nose technology, researchers focused on the entire process of sensor exposure and recovery to measure sensor output changes more precisely. They achieved an average accuracy performance of over 95% across all experiments, based on various odor components such as marijuana, methamphetamine, and tobacco. Efforts were made to optimize sensor selection through validation, ensuring robust performance across different environments. Particularly noteworthy was the introduction of a new technique involving AI analysis of patterns from all samples.

The research team integrated olfactory intelligence into the e-Nose, including the recognition of odor sensors and patterns, and the detection of substances based on AI. This enables the detection of narcotics through comprehensive inspections of airport cargo. The application of olfactory intelligence technology, particularly through AI-based substance differentiation, facilitates the detection of risks. Furthermore, this technology holds promise for applications beyond drug detection, such as detecting spoiled meat products, visitors to agricultural and livestock facilities, as well as enabling early disease diagnosis based on volatile organic compounds.

앱 UI/UX (1/9)

ETRI

AN APP CALLED 'K-GUARD' HAS BEEN DEVELOPED TO ENHANCE DAILY SAFETY

This app is planned to be expanded nationwide, providing real-time alerts for hazards such as crowd crushes, falls, and floods

Kim Yong-Woon _ ICT convergence standards Research section, Principal Researcher

ICT Strategy Research Laboratory

During the rainy season, incidents such as flooding and pedestrians falling into manholes lead to numerous accidents. What if these could be prevented beforehand? Researchers have developed a smartphone app that proactively addresses safety hazards in daily life. The app has undergone a trial service with about 200 users and then a pilot service with about 2,100 users and is now planning to be expanded nationwide, earning acclaim for its effectiveness.

The K-Guard app alerts users to various safety risks — including crowding, falls, missing persons, and health hazards — through real-time notifications. Users can photograph hazardous situations like sinkholes, broken manholes, hazardous electrical wires, or construction sites directly through the app, which uses GPS to automatically tag the location. By enabling community members to report local dangers, the app compiles comprehensive safety data. Once installed, the app alerts users about nearby hazards. Such social participation of the users acts as their social solidarity.

Clicking on hazard symbols within the app's map displays the location, a photo, and AI-analyzed safety risk information. The pilot service for the K-Guard app, which began last year in Daegu, has successfully concluded. It provided ten types of risk information, including daily hazards, air quality, public safety, health issues, missing persons, flooding, hazardous materials, and slope collapses, to the pilot service area, Daegu city, and expanded eight of these services nationwide because of geographic limitations. During this 8-month period, the AI technology was enhanced to anonymize faces and license plate numbers in photos, enhancing privacy protection.

K-Guard, a life safety prevention service app, is not solely dependent on user reports for identifying safety issues. It integrates safety data from government and public institutions and uses AI to predict and alert users to potential dangers such as lowland flooding, slope collapses, air quality issues, and the spread of infectious diseases.

A delivery driver using K-Guard mentioned, "Knowing about a danger in advance makes a significant difference in how one can handle it, and it's great to be prepared." A deaf user expressed, "Through K-Guard, I have been able to contribute to others' safety by reporting hazards, enhancing my social participation and pride."

Leveraging the success of the pilot service in Daegu and other regions last year, the research team is collaborating with various local governments to launch the service nationwide through a government-sponsored project, aiming for practical implementation.
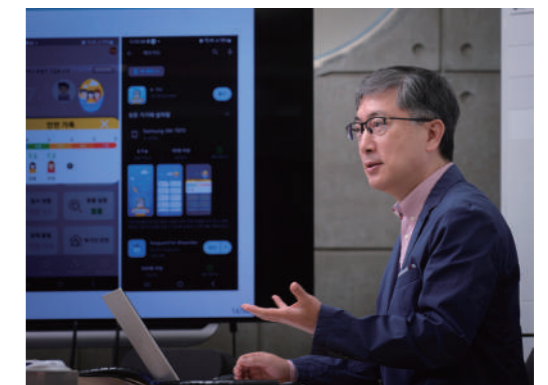
INTERNET USAGE BETWEEN CLOSE-RANGE DEVICES IS NOW POSSIBLE

The establishment of an international standard for NFC-based internet communication signals a green light for new market opportunities.

Younghwan Choi _ Strategic Standards Research Section, Principal Researcher

ICT Strategy Research Laboratory

Researchers have achieved a remarkable feat by international standardization, enabling internet communication within the close-range wireless communication technology, which has typically been limited to a 10cm radius. This is a proprietary technology pioneered by the research team.

The NFC-based internet communication technology, developed independently by the researchers has been established as an international standard by the International Internet Standardization Organization. The establishment of an international standard is crucial as it signifies that once the technology enters the market, it will be used worldwide, making it a highly significant technology often referred to as a 'golden egg.'

With the application of this technology, NFC, primarily used for communication between devices such as smartphones, tablets, and electronic devices in close proximity, can now be used for extensive internet communication. This means that internet-based communication will also be possible in NFC payment environments in the future. Offline merchants will be able to utilize existing NFC payment services without the need for additional dedicated payment terminals.

Unlike Wi-Fi or Bluetooth, which operate in relatively broad wireless signal environments, the technology standardized in this international standard utilizes narrow signal ranges, typically no more than 10cm. Consequently, there is reduced risk of security threats such as hacking that were associated with conventional communication methods. This offers the advantage of sending data more securely.

The future development of proprietary standard technologies and securing standard patents are expected to serve as a cornerstone for creating high-value outcomes in the domestic and international markets related to IoT (Internet of Things) services, including new payment and authenti-cation markets. Additionally, it opens up possibilities for leading innovations in related markets and seizing opportunities in future markets. The technology has also demonstrated its prowess internationally, having scored highly in interoperability tests organized by the European Telecommunications Standards Institute (ETSI) and being introduced as an outstanding technology by the Asia-Pacific Network Information Center (APNIC), an international organization managing internet addresses.

Furthermore, the researchers anticipate that this technology will be extremely beneficial in various IoT online and offline service environments, such as smart homes, smart buildings, and smart factories, which demand diverse forms of payment and communication methods. ETRI has been actively engaged in ongoing standardization activities and research, including the establishment of over 15 international standards, within the International Internet Standardization Organization, IETF, which is the highest authority for internet standardization.

ICT FUTURE TECHNOLOGY FOR STRATEGIC ICT R&D INVESTMENT

Identifying 8 Key Future ICT Technologies

Kim Sung Min _ Technology Economy Research Section, Director
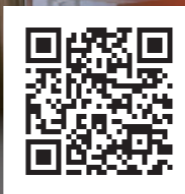
ICT Strategy Research Laboratory

Every year, various institutions such as the U.S. MIT, World Economic Forum (WEF), Gartner, and KISTEP select promising emerging technologies that have the potential to create new markets and industries in the future. Predictions about promising technologies lay the foundation for anticipating and addressing future changes.

ETRI's technology strategy researchers analyzed future changes and their drivers by linking mega trends and promising technologies, and discovered eight major ICT future technologies in the ICT field that can maximize new opportunities. ICT future technologies refer to innovative technologies including ICT and ICT convergence fields that create and lead new industrial opportunities in response to environmental changes and technological advancements.

The researchers first focused on 'ultra-realistic spatial computing' that goes beyond the limitations of screen-based terminals and enables computing in real and virtual spaces. Ultra-realistic spatial computing enables natural three-dimensional interaction without a special controller, and is expected to provide a more realistic computing environment anytime, anywhere by utilizing various XR (eXtended Reality) devices.

Next, they highlighted General Purpose Robotics. Due to advances in intelligence, specialized robots that could only perform designated tasks are expected to evolve into general-purpose robots capable of adapting flexibly to various conditions and effectively performing complex and diverse tasks.

The third noteworthy ICT future technology is 'Space Internet'. This means that the communication environment is changing from 'local wireless' to 'global wireless'. it now transitions to 'global wireless'. Space Internet is a converged infrastructure that provides ultra-low latency mobile communication services globally using satellite technology. With satellite communication included in the 6G standard, momentum for growth has been established, As major countries pursue the construction of space internet from a security perspective, development in this field is further accelerating.

Fourth, there is Customized AI Computing. While general-purpose AI computing incurs significant costs in installation and maintenance, customized AI computing refers to efficient AI computing tailored to the characteristics or purposes of specific domains, applications, data, or devices. It is a promising field optimized for applications such as autonomous driving, healthcare, and XR.

The fifth future technology is 'heterogeneous integrated packaging'. Packaging is shifting from 'single chip optimization' to 'heterogeneous small chip packaging'. Heterogeneous integration packaging is an advanced packaging technology for multifunctional high-density semiconductors developed to surpass the performance limits of single chips. It has become a significant competitive factor in the semiconductor market, with intense competition for semiconductor technology rights and an increasing pace of development.

Sixth, there's Digital Neurocare, an ICT convergence technology. Digital neurocare aims at conquering brain diseases through digital predictive medical technology, evolving from 'diagnostic AI' to 'disease and prognosis prediction AI'. Giant AI technology is rapidly penetrating the medical field, and deregulation and strengthening of policies in major countries, such as approval of medical devices and application of insurance premiums, will accelerate the development of digital medical technology.

Seventh is Digital Farming, which autonomously operates agriculture throughout its entire cycle based on AI/robotics and employs data-driven precision farming technology to adapt to environmental changes. Eighth is Digital Climate Tech, which digitally twins the Earth's complex processes to simulate its physical, chemical, and biological processes.

These ICT future technologies are an important key to converting change into opportunities. They will lead changes in future society and industry, create new market opportunities, and serve as an important driving force for sustainable growth and development. Accordingly, ETRI's technology strategy research team plans to conduct in-depth research, including R&D feasibility studies, on some of these technologies to prepare for future development at the national level.

EASIER ACCESS TO ANCIENT TEXTS LADEN WITH ANCESTORS' WISDOM

Development of AI-Based Ancient Text Translation Platform

Min Gi Hyeon _ AI Convergence Research Section, Senior Researcher

Honam Research Division

The research team has developed artificial intelligence technology to assist in translating ancient texts, which were originally written in classical Chinese characters. Traditionally, translating ancient texts has heavily relied on manual work by translators. Records such as the Royal Secretariat Diary (Seungjeongwon Ilgi) are so extensive that they have been included in the UNESCO Memory of the World Register, requiring considerable time for translation.

To address this, the research team has succeeded in developing technology that recognizes classical Chinese characters directly from the text. Characters from books dating back to the Joseon Dynasty are now inside the computer. Moreover, the platform can analyze sentences from ancient texts. After years of effort, the research team has successfully developed a platform that utilizes artificial intelligence to support the translation of classical Chinese texts.

The platform developed by the research team translates classical Chinese characters extracted from ancient texts into Korean. This means that ancient texts that have not been translated into Korean can now be translated. Through learning various styles of characters and sentence interpretation, the current accuracy rate for character recognition is 98.2%, and the translation accuracy is 85.58 out of 100 points.

The research team developed recognition technology using 24 million Chinese characters and devoted efforts to developing translation technology using 1.278 million diverse sentences. The platform also includes features for recording the translation process and inspecting characters, enabling multiple translators to collaborate on translations.

Previously, translators had to scan the original text, type it out, and visually check it. Then, multiple translations were required, consuming a lot of time and labor.

However, with the utilization of this newly developed technology, it is expected that the time and labor of professional translators for translating ancient texts can be reduced.

Currently, there are approximately 30,000 ancient texts excluding duplicates. Translating all of these books would take over 100 years, but with the integration of this technology, the time is expected to be significantly reduced.

The research team believes that in order to ensure accurate quality, AI-trained sentences need to exceed 7.5 million, and thus, they plan to further develop research and development through corpus construction.

The research team installed kiosks containing the contents of about ten translated ancient texts at 11 national libraries and cultural centers across the country, including the National Assembly Library, the National Library of Korea, and Daejeon Hanbat Library, to provide the public with empirical services for recognizing and translating classical Chinese characters. Additionally, it has been made publicly available through mobile web and applications, enabling easy access to classical Chinese text translations even for non-professional translators. While the AI currently does not reflect poetic or emotional expressions used in poetry or letters, it is anticipated that this will be addressed in the future as data accumulates.

PERSONALIZED EXERCISE COACHING AND REHABILITATION FOR MUSCULOSKELETAL DISORDERS

Development of Digital Healthcare Medical Device 'i-Mirror'

Kim Hwi-Gang _ Medical IT Convergence Research Section, Senior Researcher
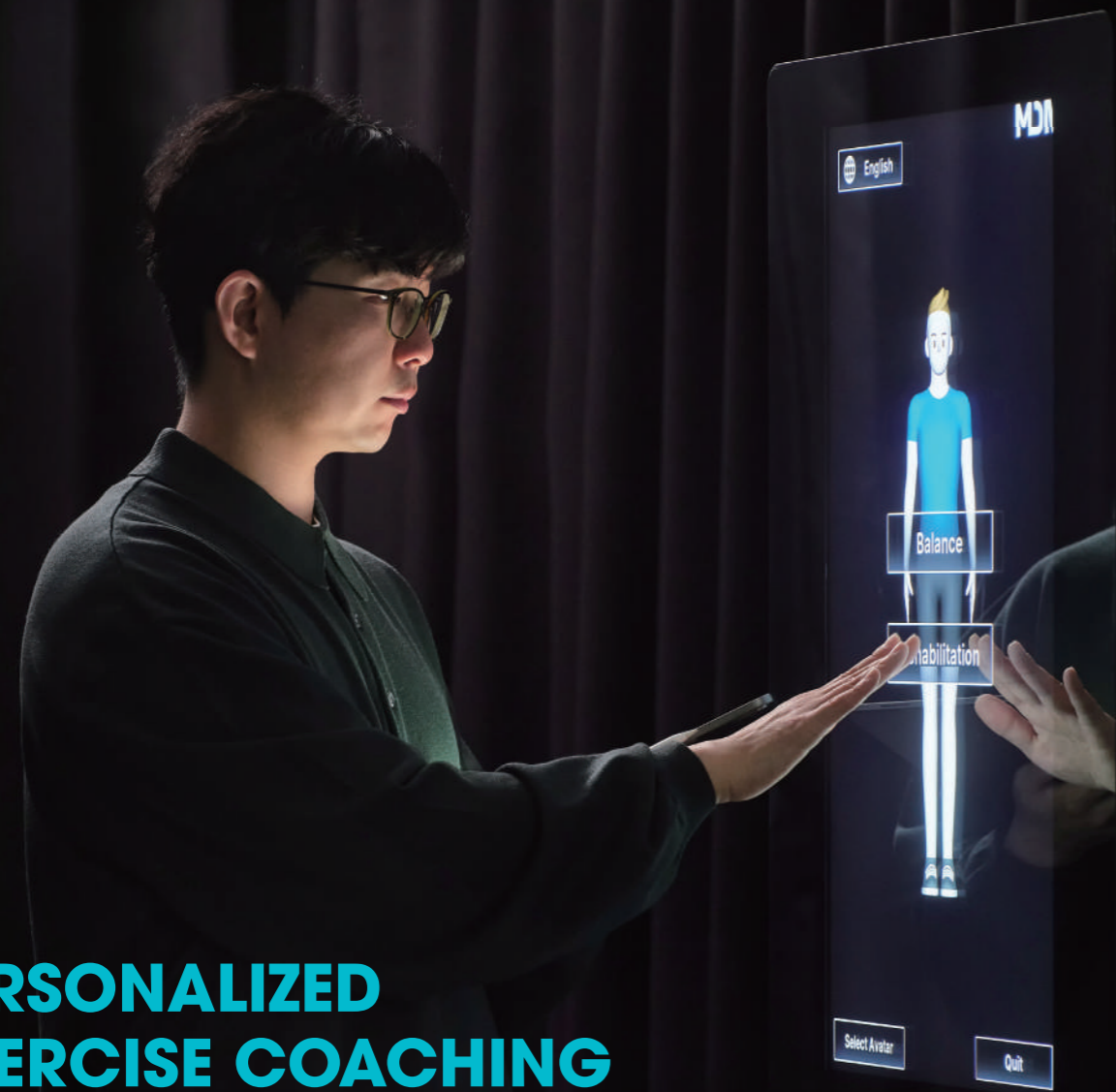
**Daegu-Gyeongbuk Research Division**

Researchers have developed a healthcare solution called 'i-Mirror,' which provides personalized exercise recommendations and coaching tailored to individuals, including rehabilitation for musculoskeletal disorders. This technology has gained significant attention as it analyzes users' posture using Artificial Intelligence (AI) and provides feedback on correct posture.

The 'i-Mirror' developed by researchers is a full-body mirror-shaped product. Using a 2D camera, it analyzes posture and recommends personalized exercises and postures. The 'Posture Analysis System' captures and analyzes users' everyday postures with their eyes closed, providing feedback for correct posture. There are two versions available : a 'Wellness Version' with 61 types of warm-up, main, and cool-down exercises, and a 'Medical Rehabilitation Recommendation Version' consisting of rehabilitation exercises recommended through analysis and recognition of musculoskeletal disorders in each body part.

The 'i-Mirror' achieved a posture recognition accuracy of over 96% using a 2D camera for posture analysis. Additionally, by establishing a 3D posture prediction recognition algorithm for each body part, it reduced the recognition distance from over 3 meters to within 2 meters, increasing spatial efficiency. Furthermore, it features the ability to recommend personalized exercises (fitness, rehabilitation) based on AI motion recognition analysis, and provide real-time feedback to users and supervisors after completion.

During the posture recognition process, most people consciously adjust their posture. To control such artificial posture adjustment behaviors and derive accurate motion analysis, the 'Posture Analysis System' was developed and patented. It can be operated independently via touchscreen without the need for experts, allowing real-time sharing of personalized exercise and rehabilitation recommendations and feedback between users and supervisors.

The technology has been commercialized through technology transfer to MDA Co., Ltd., a visual artificial intelligence specialist development company.
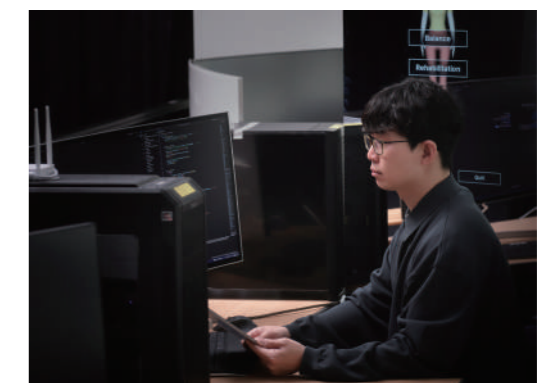
AI CARTOONIST BORN? NEW WORKS EVEN AFTER THE ARTIST'S DEATH

With the development of DeepToon, a webtoon automatic generation technology, drawing illustrations becomes possible even if you're not an artist

Chae Won Seok _ Content Intelligence Research Section, Principal Researcher

Sudogwon Research Division

A technology is being developed where an AI (Artificial Intelligence) can draw cartoons diligently once the author provides the storyline and sketches. This AI technology, which automates a significant portion of the webtoon production process, is expected to provide clues to alleviate the chronic labor issues in the webtoon industry. The technology of incorporating AI into cartoon production is called 'DeepToon'.

Since 2021, researchers have been developing 'Deep-Toon', an automatic webtoon generation technology. With this technology, AI can assist in various tasks during the webtoon production process, from refining pen lines, coloring, to drawing backgrounds, and even transforming the author's unique character images to fit various contexts. By allowing computers to perform tasks that require a lot of time and labor, productivity is being increased.

Once the author provides the scenario and initial sketches, an AI system based on deep learning utilizes information learned from existing works to assist significantly in the remaining production process. It is evaluated that it helps authors and non-professionals to produce webtoons easily and quickly.

Currently widely used cartoon production programs like 'Clip Studio' or 'Photoshop' are also focused on increasing productivity. However, there is a difference between these programs and DeepToon in that they require manual labor to compose multiple layers and produce webtoon images. Currently, these cartoon production programs are also making many attempts to incorporate AI technology.

Researchers are continuously improving DeepToon based on user satisfaction surveys conducted at each research stage and connecting authors and aspiring cartoonists to the institute for support. Researchers expect that once DeepToon is completed, it will play a significant role in resolving labor issues in webtoon production processes and accelerating industrial development.

The webtoon market has grown to the extent that annual transactions exceed 1 trillion won. While demand is skyrocketing, the production process still heavily relies on manual labor. As a result, the working hours of authors have increased while their rest time has decreased. Authors have faced difficulties in creative activities as their health deteriorates. However, with the development of DeepToon, it is expected that manual labor for authors will significantly decrease. With the utilization of AI technology, even non-professionals can easily produce quality works. This is why DeepToon is attracting attention in the industry.

Last year, researchers received favorable reviews from a survey of 210 participants, including the general public, aspiring cartoonists, academic, industrial, and professional webtoon artists, regarding their satisfaction with using DeepToon. The satisfaction level of pilot users is around 86%, and the goal is to further enhance user convenience by completing the technological development. Once DeepToon is completed, it is expected to be further improved and commercialized through private professional companies.

The greatest strength of DeepToon technology is that it can create character images created by authors using a very small amount of training data. With just 20 to 80 cuts per character, additional learning can create character images, significantly reducing the burden on authors to prepare training data in advance.

In the future, in order to continuously promote commercialization, researchers will gradually integrate DeepToon's core technology into webtoon creation commercial services, lowering the entry barrier for the general public to draw comics and expanding into new markets. Plans are also underway to establish a cyclical structure that utilizes the results provided by users with consent for relearning to further develop image-generating AI technology.

OVERVIEW

Vision & Management Goal

VISION

MANAGEMENT GOAL

Technology Pioneer
Making Happy Future
through Digital Innovation

Secure digital leadership
through innovation of growth
engine technology and achieve
sustainable growth through
ESG management innovation

MANAGEMENT PRINCIPLE

Proactive
Excellence

World-class
Impact

Harmonized
Passion

Synergistic
Collaboration

Organization

President

Audit & Inspection Department

External Relations Department

National Security
Research Institute

Executive
Vice
President

Artificial Intelligence Computing
Research Laboratory

Superintelligence Creative
Research Laboratory

Terrestrial & Non-Terrestrial
Integrated Telecommunications
Research Laboratory

Hyper-Reality Metaverse
Research Laboratory

Digital Convergence
Research Laboratory

ICT Strategy Research
Laboratory

Daegu-Gyeongbuk
Research Division

Honam
Research Division

Sudogwon
Research Division

Technology Commercialization
Division

Planning Division

Administration Division

**Technology Pioneer Making
Happy Future through Digital Innovation**

History of ETRI

1970's

1976.12.30.
KERTI ESTABLISHED
Established for electric research and testing

KIET ESTABLISHED
Established for semi-conductors and computers

1976.12.31.
KECRI WAS FOUNDED
as an affiliate of KIST Established for R&D in telecommunications technology

Established KE RTI, KIET and KECRI, the origins of ETRI

1976.12.30.
KERTI (Korea Electric Research and Testing Institute) was established

KERTI (Korea Electric Research and Testing Institute) was established

1976.12.31.
KECRI (Korea Electronics & Communications Research Institute) was founded as an affiliate of KIST

1977.12.10.
KTRI ESTABLISHED
KECRI became independent from KIST and KTRI was established on Dec 31, 1976 as a research institute specialized in telecommunications

1977.12.10.
Independent from KIST and renamed itself as KTRI

1980's

1981.01.20.
KETRI ESTABLISHED
(consolidation of KTRI and KERTI)

Established KETRI

1981.01.20.
KETRI (Korea Electrotechnology and Telecommunications Research Institute) was established in consolidation of KTRI and KERTI

1985.03.26.
ETRI ESTABLISHED
ETRI Institute specialized in information and telecommunications (consolidation of KIET and KETRI)

Established ETRI

1985.03.26.
ETRI, institute specialized in Information and Telecommunications was established (consolidation of KIET and KETRI) to meet with the emphasize on electronics field

1990's

1996.01.01.
SERI TRANSFERRED TO ETRI
SERI, data process department of KIST, transferred to ETRI as an affiliate

Data process department of KIST transferred to ETRI as an affiliate

1996.01.01.
SERI (Systems Engineering Research Institute) was opened as data process department of KIST. In accordance with government restructuring of the Ministry of Science and Technology to the Ministry of Information and Communication, SERI became affiliate of ETRI on January 1, 1996

1997.01.31.
ETRI

Korean name of ETRI officially changed

1997.01.31.
Based on regulations for electronics and telecommunications

1998.05.25.
Incorporated into ETRI

R&D Major Achievements

1970's

1976
• Established KIST affiliate, KTRI
• Established KIET
• Established KERTI

1977
• Established KTRI

1980's

1982
• Developed Korea's first memory semiconductor 32K ROM

1983
• Developed 8-bit educational computer

1984
• Localized 16-bit UNIX computer

1986
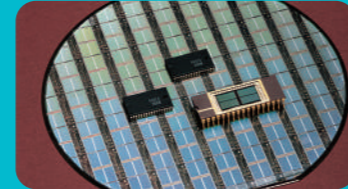∗ Developed TDX which opened the "one-household, one-telephone" era

1988
• Developed 565 Mbps optical communication system

1989
∗ Developed 4M DRAM, which led to the development of 16M, 64M, and 256M DRAM

1990's

1990
• Developed 32-bit microprocessors

1991
• Launched TDX-10
• Developed TiCOM II

1994
• Developed digital satellite broadcasting system

1995
∗ Commercialized the world's first CDMA mobile telecommunications system

1999
• Developed a synchronized IMT-2000 (CDMA2000) STP system prototype
∗ Developed and commercialized nonsynchronized IMT-2000 (WCDMA)

2000's

1996
• Developed a vehicle-mounted antenna for satellite broadcasting

2006
• Developed a wireless home network ultra-wideband (UWB)
• Developed the world's first transparent AMOLED

2007
• Developed the world's first 3.6 Gbps fourth generation mobile communications technology (NoLA)

2004
∗ Developed the world's first portable broadband Internet WiBro prototype

2005
• Exported first Korean embedded software development solution
∗ Launched terrestrial DMB services

2010's

2008
• Developed an SMMD-based realistic 4D system technology

2009
∗ Developed an eco-friendly OLED lighting technology that illuminated the world

2010
∗ Developed the world's first fourth generation LTE-Advanced technology
• Developed a smart ship technology (SAN)

2011
• Developed an adjustable transparent AMOLED display panel
• Developed a packet-optical integrated transport network technology

2012
• Developed the 100 times faster fiber-optic Internet
∗ Developed a portable automatic Korean-English interpretation app, GenieTalk
∗ The world's first terrestrial 4K UHD Broadcasting System Commercialization

2013
• Developed a DB-call-based intelligent English learning system, GenieTutor

2020's

2014
• Developed the world's first 10 Gbps OCES+3.2 Tera fiber-optic Internet

2015
• Developed an RoF-based mobile fronthaul technology (High Five ESCoRT)

2016
• Developed an optical-circuitpacket switching system

2017
• Developed a high-performance language intelligence software, Exobrain

2018
• Developed a UHD mobile broadcasting technology

2019
• Developed a 25 Gbps-class Tactile Internet TIC-TOC

2020
• Developed a visual intelligence source technology platform, Deep View

2021
• Developed core technologies for AI that understands roads, objects, and people

2022
• Developed Micro LED Transfer, Bonding Technology

2023
• Developed Factory Energy Management System (FEMS) Standard Platform for Maximizing Factory Energy Efficiency

∗ Key Representative Core Technology Recognized for Economic Ripple Effects of Over 10 Trillion Won or Global Uniqueness and Excellence.
1) Analyzing Period : November 2016 to April 2017
2) Analysis Period : 1976 to 2016 (40 years)

2024 ETRI
Technology Report